NEW YORK CITY DEPARTMENT OF DESIGN + CONSTRUCTION

PROJECT ID: E12-0023

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

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

VOLUME 3 OF 3

ADDENDUM TO THE GENERAL CONDITIONS

SPECIFICATIONS

FOR FURNISHING ALL LABOR AND MATERIALS
NECESSARY AND REQUIRED FOR:

PlaNYC Energy Audit Retrofit at Brooklyn Public Library

LOCATION: 2 Eastern Parkway
BOROUGH: Brooklyn 11238
CITY OF NEW YORK

CONTRACT NO. 1 HVAC WORK

DCAS

Loring Consulting Engineers

Date: November 20, 2014

NEW YORK CITY DEPARTMENT OF DESIGN + CONSTRUCTION

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

ADDENDUM TO THE GENERAL CONDITIONS FOR SINGLE CONTRACT PROJECTS

The General Conditions are hereby amended in accordance with the terms and conditions set forth in this Addendum.

I. PROJECT DESCRIPTION

FMS #: **E12-0023**

PROJECT NAME: **Brooklyn Public Library**
PlaNYC Energy Audit Retrofit Project

PROJECT DESCRIPTION: This Project consists of implementing several energy conservation measures that were recommended by Dome-Tech, Inc. (also known as NORESCO) in their energy audit report dated December 29, 2010. The energy conservation measures include lighting system improvements such as refurbishing T8 and T12 fluorescent fixtures with LED lamps, installing networked lighting controls for lighting in public reading spaces, installing occupancy/vacancy sensors for lighting control in restrooms and other select spaces, and HVAC system improvements including the installation of a new building management system, upgrading several HVAC units with new direct digital controls, implementing demand controlled ventilation strategy for various HVAC units, implementing outside air economizer control strategy for various HVAC units, implementing supply air temperature reset for various HVAC units, implementing hot and chilled water supply temperature resets, retrofitting existing VAV RTUs that have variable inlet vanes with VFDs and VFD-compatible motors.

PROJECT LOCATION: **2 Eastern Parkway**
BOROUGH: **Brooklyn**
CITY OF NEW YORK
ZIP CODE: **11238**
COMMUNITY BOARD #: **Community Board 355**

LANDMARK STATUS:

DESIGNATED LANDMARK STRUCTURE OR SITE: **YES**
If this is a Designated Landmark Structure or Site, Section 01 3591, Historic Treatment Procedures applies to this project.
LANDMARK QUALITY STRUCTURE: **YES**
If this is a Landmark Quality Structure, Section 01 3591, Historic Treatment Procedures applies to this project.

II. LEED GREEN BUILDING REQUIREMENTS

Not used.

III. COMMISSIONING REQUIREMENTS

This project includes Commissioning Requirements. The General Commissioning Requirements are found in Section 01 9113 of the DDC Standard General Conditions. Other specific Commissioning Requirements can be found in the Project Specification Sections.

IV. PROJECT MANAGEMENT

[X] DDC shall publicly bid and enter into all contracts for the Project. DDC shall manage the Project using its own personnel.

[ ] DDC shall publicly bid and enter into all contracts for the Project. A Construction Management firm (the "CM") hired by DDC shall manage the Project. The Contractor is advised that the CM shall serve as the representative of the Commissioner at the site and shall, subject to review by the Commissioner, be responsible for the inspection, management, coordination and administration of the required construction work, as delineated in the article of the Standard Construction Contract entitled "The Resident Engineer".

V. CONTRACTS FOR THE PROJECT

The Project consists of a single contract, the Contract for Heating, Ventilating and Air Conditioning (HVAC) Work. The Contractor for HVAC Work is responsible for the performance of all required work for the Project as set forth in the Contract Documents (General Conditions, Drawings and Specifications), including all responsibilities and obligations assigned to separate Contractors for the following subdivisions of the work: General Construction Work, Plumbing Work, and Electrical Work. All responsibilities and obligations in the Contract Documents assigned to separate Contractors for such subdivisions of the work are the responsibility of the Contractor for HVAC Work.

VI. SCHEDULES

The Contractor is advised that Schedules A through F are attached to, and incorporated as part of, this Addendum to the General Conditions. These schedules contain important information that is specific to this Project. The Contractor is advised to carefully review these schedules.

VII. APPLICABILITY OF SECTIONS/SUB-SECTIONS AND AMENDED SUB-SECTIONS

The Contractor is advised that various Sections/Sub-Sections in the General Conditions may not apply to this Project or may apply as amended. Such Sections/Sub-Sections advise the Contractor to "Refer to the Addendum for the applicability of this Section/Sub-Section." Such Sections/Sub-Sections are set forth below. A check mark indicates whether the Section/Sub-Section (1) applies to the Project, (2) does not apply to the Project, or (3) applies to the Project as amended. If no box is checked, the Section/Sub-Section, as set forth in the General Conditions, applies to the Project. Amended Sections/Sub-Sections, if any, are set forth following this list of Sections.

Section	Sub-Section	Sub-Section	Applies	Does not Apply	Applies as Amended
01 1000	1.4 (B)	Scope and Intent / LEED		X	
	1.4(C)	Scope and Intent / Commissioning	X		
01 3233		Photographic Documentation	X		
01 3300	1.7 (A-D)	LEED Submittals		X	
01 3503		General Mechanical Requirements	X		
01 3506	3.2 (A-B)	Electrical Conduit System Including Boxes (Pull, Junction and Outlet)	X		
	3.3 (A-E)	Electrical Wiring Devices	X		
	3.4 (A-I)	Electrical Conductors and Terminations	X		
	3.5 (A-B)	Circuit Protective Devices	X		
	3.6 (A-J)	Distribution Centers		X	
	3.7 (A-I)	Motors	X		
	3.8 (A-I)	Motor Control Equipment	X		
01 3591		Historic Treatment Procedures	X		
01 5000	3.2 (A)	Temporary Water Facilities / Temporary Water		X	
	3.2 (B)	Temporary Water Facilities / Temporary Water – Work in Existing Facilities		X	
	3.3 (B)	Temporary Sanitary Facilities / Self-Contained Toilet Units		X	
	3.3 (C)	Temporary Sanitary Facilities / Existing Toilets		X	
	3.4 (B) 1	Temporary Power, Lighting, and Site Lighting / Connection to Utility Lines		X	

Section	Sub-Section	Sub-Section	Applies	Does not Apply	Applies as Amended
01 5000	3.4 (B) 2	Temporary Power, Lighting, and Site Lighting / Connection to Existing Electrical Power Service		X	
	3.4 (B) 3	Temporary Power, Lighting, and Site Lighting / Electrical Generator Power Service		X	
	3.4 (D)	Temporary Power, Lighting, and Site Lighting / Temporary Lighting		X	
	3.4 (E)	Temporary Power, Lighting, and Site Lighting / Site Security Lighting (for New Construction Only)		X	
	3.5 (A-J)	Temporary Heat		X	
	3.8 (A)	DDC Field Office / Office Space in Existing Building		X	
	3.8 (B)	DDC Field Office / DDC Field Office Trailer		X	
	3.8 (B-3a)	DDC Field Office / DDC Managed Field Office Trailer	X		
	3.8 (B-3b)	DDC Field Office / CM Managed Field Office Trailer		X	
	3.8 (D)	DDC Field Office / Additional Equipment for the DDC Field Office		X	
	3.13(A-D)	Work Fence Enclosure		X	
	3.17(B)	Project Rendering		X	
	3.18 (A-C)	Security Guards / Fire Guards on Site		X	
01 5411	3.1 (A-J)	Temporary Use, Operation and Maintenance of Elevators During Construction for New Buildings Up To and Including 15 Stories		X	
	3.2 (A-M)	Temporary Use, Operation and Maintenance of Elevators During Construction for New Buildings Over 15 Stories		X	
	3.3 (A-E)	Temporary Use, Operation and Maintenance of Elevators During Construction for Existing Buildings	X		
01 7300	3.3 (A-I)	Surveys		X	
	3.4 (A-B)	Borings		X	
	3.12 (A-D)	Sleeves and Hangers	X		
	3.13 (A)	Sleeve and Penetration Drawings	X		
	3.15 (A)	Location of Partitions		X	
01 7419	1.5 (C)	Waste Management Performance Requirements / LEED Certification		X	
01 7900		Demonstration and Owner's Pre-Acceptance Orientation	X		
	3.2 (A)	Non-Commissioned Projects		X	
	3.2 (B)	Commissioned Projects	X		
01 8113		Sustainable Design Requirements for LEED Buildings		X	
01 8113.13		VOC Limits for Adhesives, Sealants, Paints and Coatings for LEED Buildings		X	
01 8119		Indoor Air Quality Requirements for LEED Buildings		X	
01 9113		General Commissioning Requirements			X

AMENDED SECTIONS/SUB-SECTIONS

The Contractor is advised that the amended Sub-Sections set forth below are included in the General Conditions and apply to the Project.

Reference Section 01 9113 General Commissioning Requirements:

Section 019113 of the DDC General Conditions is replaced with Section 019113 of the Contract Specifications

VIII. SPECIAL EXPERIENCE REQUIREMENTS FOR THE PROJECT

Not used.

IX. REVISIONS: SPECIFICATIONS AND CONTRACT DRAWINGS

The Specifications and the Contract Drawings for the Project are revised in accordance with the provisions set forth below.

(1) Owner: Wherever the term "Owner" is used in the Specifications and/or the Contract Drawings, such term shall mean the City of New York.

(2) Other Entities: In the event any entity other than the City of New York is referred to or named as the "Owner" in the Specifications and/or the Contract Drawings, the name of such other entity is deemed deleted and replaced with the "City of New York".

(3) Architect / Engineer: Wherever the words "Architect", "Engineer", "Architect / Engineer" or "Architect and/or Engineer" are used in the Specifications and/or the Contract Drawings, such words are deemed deleted and replaced with the word "Commissioner".

(4) Products / Manufacturers: Wherever the Specifications and/or the Contract Drawings require the contractor to provide a particular product (i.e., material and/or equipment) from a designated manufacturer and/or vendor, the term "or approved equal" is deemed inserted, even if only one product and/or manufacturer is specified, except as otherwise provided below.

(a) Proprietary Items: If the Bid Booklet contains a Notice which identifies a particular product from a designated manufacturer as a "Proprietary Item", the Contractor shall be required to provide such specified product. In such case, no substitution or "approved equal" will be permitted.

(5) Special Experience Requirements: Special Experience Requirements for the Project, if any, are set forth in the Bid Booklet. Special Experience Requirements may apply to contractors, subcontractors, installers, manufacturers and/or suppliers. If the Specifications and/or the Contract Drawings contain any Special Experience Requirement that is not set forth in the Bid Booklet, such Special Experience Requirement is deemed deleted, except as otherwise provided below.

(a) Any Special Experience Requirement that provides that the entity performing the work or supplying the material must have more than three (3) years of experience, is revised to provide that the entity performing the work or supplying the material must have three (3) years of experience, except as described in paragraph (b) below.

(b) Any Special Experience Requirement that pertains to the abatement of hazardous materials shall not be subject to the deletion and/or revision set forth above. Such Special Experience Requirement shall remain in full force and effect.

(c) Any Special Experience Requirement that provides that the entity performing the work must be licensed, authorized, certified, approved by or acceptable to the manufacturer, is deemed deleted and replaced with the requirement that such entity must be properly trained for the specified work.

(d) Any Special Experience Requirement that provides that the individual workers performing the work must be licensed, authorized, certified, approved by or acceptable to the manufacturer, is deemed deleted and replaced with the requirement that such individual workers must be properly trained for the specified work.

(6) Alternate Bids: If the agency is requesting the submission of Alternate Bids, a Notice regarding such Alternate Bids is set forth in the Bid Booklet. In the event of any conflict or inconsistency between (1) the Notice regarding Alternate Bids set forth in the Bid Booklet and (2) a provision in the Specifications and/or the Contract Drawings regarding Alternate Bids, the Notice set forth in the Bid Booklet shall prevail. If the agency is not requesting the submission of Alternate Bids, as indicated by the absence of a Notice in the Bid Booklet, and the Specifications and/or the Contract Drawings contain any provision regarding Alternate Bids, such provision is deemed deleted.

(7) Contractor Retained Engineer: If the Specifications and/or the Contract Drawings require the Contractor to retain an Engineer to provide engineering services for the Project, the following sentence is deemed inserted: "Such Engineer must be a Professional Engineer, licensed in the State of New York."

(8) LEED Related Provisions: If the Specifications and/or the Contract Drawings require the Contractor to purchase FSC certified wood, rapidly renewable materials, or materials within 500 miles, such provisions are deemed deleted and replaced with the requirement that if the contractor has purchased FSC certified wood, rapidly renewable materials, or materials within 500 miles, the contractor shall submit such forms or documentation as may be required by the City in order for the USGBC to certify that the Project qualifies for the related LEED credit(s).

(9) Guarantees: Requirements for Guarantees and Maintenance are set forth in Schedule B, which is included in the Addendum to the General Conditions. In the event of any conflict or inconsistency between (1) a guarantee and/or maintenance requirement set forth in the Specifications and/or the Contract Drawings and (2) a guarantee and/or maintenance requirement set forth in Schedule B, the guarantee and/or maintenance requirement set forth in Schedule B shall prevail.

(10) Warranties: Requirements for Warranties are set forth in Schedule B, which is included in the Addendum to the General Conditions.

(a) In the event of any conflict or inconsistency between (1) a warranty requirement set forth in the Specifications and/or the Contract Drawings and (2) a warranty requirement set forth in Schedule B, the warranty requirement set forth in Schedule B shall prevail.

(b) In the event a warranty requirement set forth in the Specifications and/or the Contract Drawings is omitted from Schedule B, such omission from Schedule B shall have no effect and the Contractor's obligation to provide the manufacturer's warranty, as set forth in the Specifications and/or the Contract Drawings, shall remain in full force and effect.

(c) In the event a warranty requirement for a particular item of material or equipment is omitted from Schedule B, as well as from the Specifications or the Contract Drawings, and the manufacturer of such item actually provides a warranty, the Contractor shall be obligated to obtain and deliver to the Commissioner the highest level of warranty actually provided by that manufacturer.

(11) Exculpatory Provisions: In the event the Specifications and/or the Contract Drawings contain any provision whereby the consultant and/or any of its officers, employees or agents, including subconsultants, is absolved of responsibility for any act or omission, such provision is deemed deleted.

(12) Insurance: Provisions regarding insurance coverage the Contractor is required to provide are set forth in Article 22 of the City of New York Standard Construction Contract and Schedule A, which is included in the Addendum to the General Conditions. In the event the Specifications and/or the Contract Drawings contain any provision regarding insurance requirements, such provision is deemed deleted.

(13) Indemnification: Provisions regarding indemnification are set forth in Articles 7, 12, 22 and 57 of the City of New York Standard Construction Contract. In the event the Specifications and/or the Contract Drawings contain any provision regarding indemnification, such provision is deemed deleted.

(14) Dispute Resolution: Provisions regarding dispute resolution are set forth in Article 27 of the City of New York Standard Construction Contract. In the event the Specifications and/or the Contract Drawings contain any provision regarding dispute resolution, such provision is deemed deleted.

(15) Payment to Other Entities: In the event the Specifications and/or the Contract Drawings contain any provision which requires the Contractor to make payments to an entity other than a subcontractor and/or supplier providing services and/or material for the project, such provision is deemed deleted.

(16) General Conditions: In the event of any conflict or inconsistency between (1) the Specifications and/or the Contract Drawings and (2) the General Conditions, the General Conditions shall prevail.

(17) Standard Construction Contract: In the event of any conflict or inconsistency between (1) the Specifications and/or the Contract Drawings and (2) the City of New York Standard Construction Contract, the City of New York Standard Construction Contract shall prevail.

SCHEDULE A (FOR PUBLICLY BID PROJECTS)
Contract Requirements

Various Articles of the Contract refer to requirements which are set forth in Schedule A of the General Conditions. The Schedule set forth below specifies the following: (1) the referenced Articles of the Contract, and (2) the specific requirements applicable to each separate contract.

REFERENCE	ITEM	REQUIREMENTS	CONTRACT #1	
Information For Bidders	Bid Security		See Attachment 1 – Bid Information in the Bid Booklet	
Information For Bidders	Performance and Payment Bonds		See Attachment 1- Bid Information in the Bid Booklet	
Article 14 Contract	Time of Completion	Consecutive Calendar Days	720	
Article 15 Contract	Liquidated Damages	For each consecutive calendar day over completion time	**$600**	
Article 17 Contract	Sub-Contracts	Not to exceed Percent of Contract Price	**60%**	
Article 21 Contract	Retainage	Percent of Voucher	If 100% bonds are required	**5%**
			If 100% bonds are not required, and Contract Price is less than $1,000,000	**10%**
			If 100% bonds are not required, and Contract Price is more than $1,000,000	**10%**
Article 24 Contract	Deposit Guarantee	Percent of Contract Price	**1%**	
Article 24 Contract	Period of Guarantee		See Schedule B of the Addendum to the General Conditions	
Article 74 Contract	Statement of Work		See Contract Article 74	
Article 75 Contract	Compensation to be Paid to Contractor		See Contract Article 75	
Article 78 Contract	MWBE Program		See M/WBE Utilization Plan in the Bid Booklet	

SCHEDULE A (FOR PUBLICLY BID PROJECTS)

Relating to Article 22 - Insurance

PART II. Types of Insurance, Minimum Limits and Special Conditions

Note: All certificate(s) of insurance submitted pursuant to Contract Article 22.3. 3 must be accompanied by a Certification by Broker consistent with Part III below and include the following information:

- **For each insurance policy, the name and NAIC number of issuing company, number of policy, and effective dates;**
- **Policy limits consistent with the requirements listed below;**
- **Additional insureds or loss payees consistent with the requirements listed below; and**
- **The number assigned to the Contract by the City (in the "Description of Operations" field).**

Insurance indicated by a blackened box (■) or by (X) in the ☐ to left will be required under this contract.

Types of Insurance (per Article 22 in its entirety, including listed paragraph)	Minimum Limits and Special Conditions
■ Commercial General Liability Art. 22.1.1	The minimum limits shall be $1,000,000.00 per occurrence and $2,000,000.00 per project aggregate applicable to this **Contract.** Additional Insureds: 1. City of New York, including its officials and employees, with coverage at least as broad as ISO Forms CG 20 10 and CG 20 37, and 2. All person(s) or organization(s), if any, that Article 22.1.1(b) of the **Contract** requires to be named as Additional Insured(s), with coverage at least as broad as ISO Form CG 20 26. The Additional Insured endorsement shall either specify the entity's name, if known, or the entity's title (e.g., Project Manager). 3. Brooklyn Public Library
■ Workers' Compensation Art. 22.1.2 ■ Disability Benefits Insurance Art. 22.1.2 ■ Employers' Liability Art. 22.1.2 □ Jones Act Art. 22.1.3 □ U.S. Longshoremen's and Harbor Workers Compensation Act Art. 22.1.3	Workers' Compensation, Employers' Liability, and Disability Benefits Insurance: Statutory per New York State law without regard to jurisdiction. **Note**: The following forms are acceptable: (1) New York State Workers' Compensation Board Form No. C-105.2, (2) State Insurance Fund Form No. U-26.3, (3) New York State Workers' Compensation Board Form No. DB-120.1 and (3) Request for WC/DB Exemption Form No. CE-200. The City will not accept an ACORD form as proof of Workers' Compensation or Disability Insurance. Jones Act and U.S. Longshoremen's and Harbor Workers' Compensation Act: Statutory per U.S. law.

SCHEDULE A (FOR PUBLICLY BID PROJECTS)

Relating to Article 22 - Insurance

PART II. Types of Insurance, Minimum Limits and Special Conditions

Insurance indicated by a blackened box (■) or by (X) in the ☐ to left will be required under this contract.

Types of Insurance (per Article 22 in its entirety, including listed paragraph)		Minimum Limits and Special Conditions
■ Builders' Risk	Art. 22.1.4	100 % of total value of **Work** **Contractor** the Named Insured; the **City** both an Additional Insured and one of the loss payees as its interests may appear. If the **Work** does not involve construction of a new building or gut renovation work, the **Contractor** may provide an installation floater in lieu of Builders Risk insurance. Note: Builders Risk Insurance may terminate upon **Substantial Completion** of the **Work** in its entirety.
■ Commercial Auto Liability	Art. 22.1.5	$1,000,000.00 per accident combined single limit If vehicles are used for transporting hazardous materials, the **Contractor** shall provide pollution liability broadened coverage for covered vehicles (endorsement CA 99 48) as well as proof of MCS 90
☐ Contractor's Pollution Liability	Art. 22.1.6	$_____ per occurrence $_____ aggregate Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____
☐ Marine Protection and Indemnity	Art. 22.1.7(a)	$_____ per occurrence $_____ aggregate Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____

SCHEDULE A (FOR PUBLICLY BID PROJECTS)

Relating to Article 22 - Insurance

PART II. Types of Insurance, Minimum Limits and Special Conditions (Continued)

Insurance indicated by a blackened box (■) or by (X) in the ☐ to left will be required under this contract.

Types of Insurance (per Article 22 in its entirety, including listed paragraph)	Minimum Limits and Special Conditions
□ Hull and Machinery Insurance Art. 22.1.7(b)	$_____ per occurrence $_____ aggregate Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____
□ Marine Pollution Liability Art. 22.1.7(c)	$_____ each occurrence Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____
[OTHER] Art. 22.1.8 □ Ship Repairers Legal Liability	$_____ each occurrence [Contracting agency to fill in total value of City vessels involved]
[OTHER] Art. 22.1.8 □ Collision Liability/Towers Liability	$_____ per occurrence $_____ aggregate Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____
[OTHER] Art. 22.1.8 □ Railroad Protective Liability _____	$_____ per occurrence $_____ aggregate Additional Insureds: 1. City of New York, including its officials and employees, and 2. _____ 3. _____

SCHEDULE A (FOR PUBLICLY BID PROJECTS)

Relating to Article 22 - Insurance

PART II. Types of Insurance, Minimum Limits and Special Conditions (Continued)

Insurance indicated by a blackened box (■) or by (X) in the ☐ to left will be required under this contract.

[OTHER] Art. 22.1.8 ■ Asbestos Liability _____	Only required of the Contractor or Subcontractor performing any required asbestos removal. $1,000,000 each occurrence, $2,000,000 aggregate (Combined Single Limit); only required of the Contractor or Subcontractor performing any required asbestos removal. Additional Insureds: 1. City of New York, including its officials and employees, and 2. Brooklyn Public Library
[OTHER] Art. 22.1.8 □ Boiler Insurance_____	$200,000
[OTHER] Art. 22.1.8 ■ Professional Liability In the event any section of the Specifications requires the Contractor to engage a Professional Engineer to provide design and/or engineering services, the Engineer engaged by the Contractor, as well as any sub consultant(s) performing professional services, shall provide Professional Liability Insurance.	$1,000,000 per occurrence The Contractor's Professional Engineer shall maintain and submit evidence of Professional Liability Insurance in the minimum amount of $1,000,000 per claim. The policy or policies shall include an endorsement to cover the liability assumed by the Contractor under this Agreement arising out of the negligent performance of professional services or caused by an error, omission or negligent act of the Contractor's Professional Engineer or anyone employed by the Contractor's Professional Engineer. Claims-made policies will be accepted for Professional Liability Insurance. All such policies shall have an extended reporting period option or automatic coverage of not less than two (2) years. If available as an option, the Contractor's Professional Engineer shall purchase extended reporting period coverage effective on cancellation or termination of such insurance unless a new policy is secured with a retroactive date, including at least the last policy year.

SCHEDULE A (FOR PUBLICLY BID PROJECTS)

Relating to Article 22 - Insurance

PART III. Broker's Certification

[Pursuant to Article 22.3.3 of the **Contract**, every Certificate of Insurance must be accompanied by either the following certification by the broker setting forth the following text and required information and signatures or certified copies of all policies referenced in the Certificate of Insurance.]

CERTIFICATION BY BROKER

The undersigned insurance broker represents to the City of New York that the attached Certificate of Insurance is accurate in all material respects, and that the described insurance is effective as of the date of this Certification.

_____
[Name of broker (typewritten)]

_____
[Address of broker (typewritten)]

_____
[Email address of broker (typewritten)]

_____
[Phone number/Fax number of broker (typewritten)]

_____
[Signature of authorized official or broker]

_____
[Name and title of authorized official (typewritten)]

State of .....)
) ss:
County of .....)

Sworn to before me this

_____ day of _____, 20__

_____

NOTARY PUBLIC FOR THE STATE OF_____

SCHEDULE A (FOR PUBLICLY BID PROJECTS)

Relating to Article 22 - Insurance

PART IV. Address of Commissioner

Wherever reference is made in Article 7 or Article 22 to documents to be sent to the **Commissioner** (e.g., notices, filings, or submissions), such documents shall be sent to the address set forth below or, in the absence of such address, to the **Commissioner's** address as provided elsewhere in this **Contract**.

ACCO's Office, Insurance Unit

30-30 Thomson Avenue, 4th Floor

Long Island City, New York 11101

SCHEDULE B

Guarantees and Warranties

(Reference: Section 01 7839, Article 2.7 of the DDC Standard General Conditions)

GUARANTY FROM CONTRACTOR

(1) Contractor's Guaranty Obligation: The Contractor shall promptly repair, replace, restore or rebuild, as the Commissioner may determine, any finished Work in which defects of materials or workmanship may appear or to which damage may occur because of such defects, during the one (1) year period subsequent to the date of Substantial Completion (or use and occupancy in accordance with the Contract), except for the areas of Work set forth below:

- Roofing, Waterproofing, and Joint Sealant Work. For these types of work, the guarantee period shall be (2) two years.

- Trees and/or Plant Material. For trees and/or plant material furnished and installed, the guarantee period shall be (2) two years. During the guarantee period, the Contractor shall provide all maintenance services set forth in the Specifications.

(2) Guaranty Period: The obligation of the Contractor, and its Surety under the Performance Bond, is limited to the period(s) of time specified above.

(3) Other Provisions Deemed Deleted: In the event the Specifications and/or the Contract Drawings contain any provisions regarding guaranty requirements, such provisions are deemed deleted and replaced with the guaranty requirements set forth in this Schedule B.

****

WARRANTY FROM MANUFACTURER

(1) Contractor's Obligation to Provide Warranties: The items of material and/or equipment for which manufacturer warranties are required are listed below. For each item of material and/or equipment listed below, the Contractor shall obtain a written warranty from the manufacturer. Such warranty shall provide that the material or equipment is free from defects for the period set forth below and will be replaced or repaired within such specified period. The Contractor shall deliver all required warranties to the Commissioner.

(2) Required Warranties:

Specification Number	Material or Equipment	Warranty Period
230514	VFD	2 years
230900	Characterized control valves	5 years
260923	Ceiling-mounted Occupancy Sensors	5 years
260923	Wall-mounted vacancy & occupancy sensors	5 years
260923	Wall-mounted Dimming Controller	5 years
260943	Lighting Management Hub	5 years
260943	Lighting Management system software	5 years
260943	Wired sensors	5 years
260943	Network Lighting Controls Accessories	5 years
265100	Fluorescent Instant Start Ballast	1 year
265100	CFL Program Start Ballast	1 year
265100	Emergency Ballast	5 years
265100	LED Lamps	1 year

(3) Application: The obligations under the warranty for the periods specified above shall apply only to the manufacturer of the material or equipment, and not to the Contractor or its Surety; provided, however, the

Contractor retains responsibility for obtaining all required warranties from the manufacturers and delivering the same to the Commissioner.

(4) Other Provisions: The warranty requirements set forth in this Schedule B are also included in the Specifications.

(a) In the event of any conflict between a warranty requirement set forth in the Specifications and a warranty requirement set forth in Schedule B, the warranty requirement set forth in Schedule B shall take precedence.

(b) In the event a warranty requirement set forth in the Specifications is omitted from Schedule B, such omission from Schedule B shall have no effect and the Contractor's obligation to provide the manufacturer's warranty, as set forth in the Specifications, shall remain in full force and effect

(c) In the event a warranty requirement for a particular item of material or equipment is omitted from both Schedule B and the Specifications, and the manufacturer of such item actually provides a warranty, the Contractor shall be obligated to obtain and deliver to the Commissioner the highest level of warranty actually provided by that manufacturer.

(d) In the event a warranty requirement is provided for a particular item of material or equipment, and such requirement specifies a warranty period that is longer than that which is actually provided by any of the specified manufacturers, the Contractor shall be obligated to obtain and deliver to the Commissioner the highest level of warranty actually provided by any of the specified manufacturers, unless otherwise directed in writing by the Commissioner.

(e) Unless indicated otherwise Warranties are to take effect on the date of Substantial Completion.

SCHEDULE C

Contract Drawings

(Reference: Section 01 1000, Article 1.5 (A) of the DDC Standard General Conditions)

The Schedule set forth below lists all Contract Drawings for the Project.

T001.00	Title Sheet
T002.00	General Notes, Building Department Notes and Phasing Notes
H001.00	Asbestos Abatement General Notes
H002.00	Asbestos Abatement Second Floor Plan
M001.00	Mechanical Symbols, Notes, and Abbreviations
M100.00	Mechanical Key Plans
M301.00	Mechanical Sub-basement (Deck 1) Part Plan Sheet No.1
M302.00	Mechanical Sub-basement (Deck 1) Part Plan Sheet No.2
M303.00	Mechanical Sub-basement (Deck 1) Part Plan Sheet No.3
M304.00	Mechanical Sub-basement (Deck 1) Part Plan Sheet No.4
M305.00	Mechanical Sub-basement (Deck 1) Part Plan Sheet No.5
M306.00	Mechanical Basement Part Plan Sheet No.1
M307.00	Mechanical Basement Part Plan Sheet No.2
M308.00	Mechanical First Floor Part Plan Sheet No.1
M309.00	Mechanical First Floor Part Plan Sheet No.2
M310.00	Mechanical Second Floor Part Plan Sheet No.1
M311.00	Mechanical Second Floor Part Plan Sheet No.2
M312.00	Mechanical Second Floor Part Plan Sheet No.3
M313.00	Mechanical Second Floor Part Plan Sheet No.4
M314.00	Mechanical Third Floor Part Plan Sheet No.1
M315.00	Mechanical Third Floor Part Plan Sheet No.2
M316.00	Mechanical Third Floor Part Plan Sheet No.3
M317.00	Mechanical Third Floor Part Plan Sheet No.4
M318.00	Mechanical Roof Part Plan Sheet No.1
M319.00	Mechanical Roof Part Plan Sheet No.2
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M321.00	Mechanical Roof Part Plan Sheet No.4
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M401.00	Mechanical Schedules Sheet No.1
M402.00	Mechanical Schedules Sheet No.2
M501.00	Mechanical Details Sheet No.1
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M701.00	Mechanical Controls Sheet No.1 – BMS System Arch
M702.00	Mechanical Controls Sheet No.2 – AC-1, 5 & 6 Controls
M703.00	Mechanical Controls Sheet No.3 – AC-3 Controls
M704.00	Mechanical Controls Sheet No.4 – AC-7 Controls
M705.00	Mechanical Controls Sheet No.5 – AC-8 Controls
M706.00	Mechanical Controls Sheet No.6 – AC-9 Controls
M707.00	Mechanical Controls Sheet No.7 – AC-11 Controls
M708.00	Mechanical Controls Sheet No.8 – AC-12 & 13 Controls
M709.00	Mechanical Controls Sheet No.9 – AHU-B-1 Controls
M710.00	Mechanical Controls Sheet No.10 – AHU-B-2 Controls
M711.00	Mechanical Controls Sheet No.11 – AHU-1, 2 & 3 Controls
M712.00	Mechanical Controls Sheet No.12 – AHU- 6A & 6B Controls
M713.00	Mechanical Controls Sheet No.13 – H&V Unit Controls
M714.00	Mechanical Controls Sheet No.14 – AHU-19 Controls
M715.00	Mechanical Controls Sheet No.15 – FCU & CRAC Unit Controls
M716.00	Mechanical Controls Sheet No.16 – AH-1, 2 & 5 (Future Units) Controls

M717.00	Mechanical Controls Sheet No.17 – RTU & EF Controls
M718.00	Mechanical Controls Sheet No.18 – VAV Controls & Starter Details
M719.00	Mechanical Controls Sheet No.19 – Chiller Controls
M720.00	Mechanical Controls Sheet No.20 – Chiller Controls
M721.00	Mechanical Controls Sheet No.21 – Cooling Tower Controls
M722.00	Mechanical Controls Sheet No.22 – Boiler Controls
M723.00	Mechanical Controls Sheet No.23 – HW Conv. & DHW Controls
M724.00	Mechanical Controls Sheet No.24 – HW Conv. & DHW Controls
M725.00	Mechanical Air Flow Riser
E001.00	Electrical Symbols, Abbreviations, and Notes
E101.00	Electrical Sub-basement Deck 1 Floor Plan
E102.00	Electrical Sub-basement Deck 2 Floor Plan
E103.00	Electrical Sub-basement Deck 3 Floor Plan
E104.00	Electrical Sub-basement Deck 4 Floor Plan
E105.00	Electrical First Floor Plan
E106.00	Electrical First Floor Part Plans
E107.00	Electrical Second Floor Plan
E108.00	Electrical Third Floor Plan
E109.00	Electrical Roof Plan
E401.00	Electrical Fixture Replacement Schedule Sheet No.1
E402.00	Electrical Fixture Replacement Schedule Sheet No.2
E403.00	Electrical Fixture Replacement Schedule Sheet No.3
E501.00	Electrical Details and Schedules
E502.00	Electrical Details and Schedules

SCHEDULE D

Electrical Motor Control Equipment

(Reference: 01 3506, Article 3.8 of the DDC Standard General Conditions)

Requirements for electrical motor equipment may be included in one or more sections of the Specifications for the Contract for the Project. Schedule D set forth below delineates specific information for electrical motor control equipment. In the event of any conflict between the Specifications and this Schedule D, Schedule D shall take precedence; provided, however, in the event of an omission from Schedule D (i.e., Schedule D omits either a reference to or information concerning electrical motor equipment which is set forth in the Specifications), such omission from Schedule D shall have no effect and the Contractor's obligation with respect to the electrical motor control equipment, as set forth in the Specifications, shall remain in full force and effect.

DB Disconnect Circuit Breaker (Switch)
TS Thermal Switch
MS Magnetic Starter
CMS Comb. Mag. Starter
P Pilot Light
F Firestat
T Thermostat
AL Alternator
BG Break Glass Station
HOA Hand-Off Auto.
PB Push Button Station
RO Remote "off"

Equip. Ident.	Location	# of Units	HP or KW	Volts and Phase	Control Type: See legend above	Remarks:
AC-8	Stacks	1	30 hp	208/3	HOA	
AC-5, AC-6, AC-7, EX-8	Various	4	20 hp	208/3	HOA	
AC-3 AC-11, RTU-1, RTU-2	Various	4	15 hp	208/3	HOA	
S-1, EF-18	Various	2	10 hp	208/3	HOA	
AC-13, EX-6, EX-5	Various	3	7.5 hp	208/3	HOA	
AC-9, E-1, EX-7, RTU-1E, RTU-2E	Various	7	5 hp	208/3	HOA	
H-1, AC-12, EX-13	Various	3	3 hp	208/3	HOA	
EX-12	Circ. Room	1	1 hp	208/3	HOA	

SCHEDULE E

Separation of Trades

NOT USED FOR SINGLE CONTRACTS

SCHEDULE F

Submittals Schedule

(Reference: Section 01 3300 Article 1.5 (C) of the General Conditions)

The Schedule set forth below lists all submittal requirements for the Contract. In the event of any conflict between the Specifications and this Schedule F, Schedule F shall take precedence; provided, however, in the event of an omission from Schedule F (i.e., Schedule F omits either a reference to or information concerning a submittal requirement which is set forth in the Specifications), such omission from Schedule F shall have no effect and the Contractor's submittal obligation, as set forth in the Specifications, shall remain in full force and effect.

CONSULTANT: Loring Consulting Engineers
TELEPHONE NUMBER: (212) 543-7400
DDC PROJECT MANAGER: Kristina Blazevski-Charpentier
TELEPHONE NUMBER: (718) 391-1737

DATE: _____

APPROVED: _____
(DDC RESIDENT ENGINEER/CPM)

REPORT DATE		FMS ID #/PROJECT ID #: E12-0023 CONTRACT REGISTRATION #: PROJECT NAME: Brooklyn Public Library							CONTRACT #: **Contract 1 – GENERAL CONSTRUCTION** TRADE: SHOP DRAWING LOG SHEET #								
SPEC. SECT. #	DESCRIPTION	COORD. WITH CONTR.	SUBMITTAL			SUB. DATE	REQ'D DEL.	FABRIC. TIME	SUBMISSIONS								
			SHOP DWG.	SAMPLE	CAT. CUTS				REC'D	RET'D	ACTION	REC'D	RET'D	ACTION	REC'D	RET'D	ACTION
01 3526	Safety and Health Program	X															
01 3526	Contractor's Safety Plan	X															
01 3526	Historic Treatment Plan	X															
01 5000	Site Plan		X														
01 5000	Reports	X															
01 5423	NYC DOB Scaffold & Sidewalk Shed Permits	X	X														
01 5423	Site Logistics/Site Safety Plan	X															

REPORT DATE		FMS ID #/PROJECT ID #: E12-0023 CONTRACT REGISTRATION #: PROJECT NAME: Brooklyn Public Library							CONTRACT #: **Contract 1 – GENERAL CONSTRUCTION** TRADE: SHOP DRAWING LOG SHEET #								
SPEC. SECT. #	DESCRIPTION	COORD. WITH CONTR.	SUBMITTAL			SUB. DATE	REQ'D DEL.	FABRIC. TIME	SUBMISSIONS								
			SHOP DWG.	SAMPLE	CAT. CUTS				REC'D	RET'D	ACTION	REC'D	RET'D	ACTION	REC'D	RET'D	ACTION
01 5423	Scaffold & Shed Installation Drawings		X														
01 7419	Waste Management Plan	X															
01 7900	Instruction Program for Demonstration & Orientation	X															
01 7900	Qualification Data	X															
01 8113.13	MSDS			X	X												
01 8119	IAQ Management Plan	X															
01 8119	Product Cut Sheets				X												
01 8119	IAQ Management Plan Photographs	X															
07 8400	Firestopping Smoke Seals		X		X												
09 2900	Gypsum Board	X			X												
09 5113	Acoustical Panel Ceilings	X			X												
09 9000	Interior Painting	X			X												
23 0500	Coordination Drawings		X	X													
	Operation and Maintenance Manuals			X													

REPORT DATE		FMS ID #/PROJECT ID #: E12-0023 CONTRACT REGISTRATION #: PROJECT NAME: Brooklyn Public Library							CONTRACT #: **Contract 1 – GENERAL CONSTRUCTION** TRADE: SHOP DRAWING LOG SHEET #								
SPEC. SECT. #	DESCRIPTION	COORD. WITH CONTR.	SUBMITTAL			SUB. DATE	REQ'D DEL.	FABRIC. TIME	SUBMISSIONS								
			SHOP DWG.	SAMPLE	CAT. CUTS				REC'D	RET'D	ACTION	REC'D	RET'D	ACTION	REC'D	RET'D	ACTION
	Record Drawings		X	X													
	Access Doors				X												
23 0501	Scope of HVAC work	X															
23 0503	Pipes		X		X												
23 0513	Motor				X												
23 0514	Motor Controls				X												
23 0523	Valves				X												
23 0529	Hangers/ Supports		X		X												
	Firestopping		X		X												
23 0553	Identification		X	X	X												
23 0593	Testing, Adjusting & Balancing		X														
230700	Insulation			X	X												
23 0900	Instrumentation and Control for HVAC		X	X	X												
23 0923	DDC Controls		X		X												
230993	Sequence of Operation for HVAC Controls		X														
232116	Hydronic Piping Specialties				X												
232216	Steam Piping Specialties				X												

REPORT DATE		FMS ID #/PROJECT ID #: E12-0023 CONTRACT REGISTRATION #: PROJECT NAME: Brooklyn Public Library							CONTRACT #: **Contract 1 – GENERAL CONSTRUCTION** TRADE: SHOP DRAWING LOG SHEET #								
SPEC. SECT. #	DESCRIPTION	COORD. WITH CONTR.	SUBMITTAL			SUB. DATE	REQ'D DEL.	FABRIC. TIME	SUBMISSIONS								
			SHOP DWG.	SAMPLE	CAT. CUTS				REC'D	RET'D	ACTION	REC'D	RET'D	ACTION	REC'D	RET'D	ACTION
233100	HVAC Ducts and Casings		X		X												
	Terminal Units		X		X												
	Duct Liner				X												
	Duct Connectors				X												
	Test Report		X														
23 3300	Flexible duct connections		X		X												
	Volume Dampers		X		X												
	Cable Control Dampers		X		X												
	Duct Access Doors		X		X												
	Duct Test Holes		X		X												
23 3400	HVAC Fans				X												
26 0500	Coordination Drawings		X	X													
	Operating and Maintenance Manuals			X													
	Record Drawings		X	X													
	Access Doors				X												
26 0503	Equipment Wiring Connections				X												
26 0519	Building Wire				X												

REPORT DATE		FMS ID #/PROJECT ID #: E12-0023 CONTRACT REGISTRATION #: PROJECT NAME: Brooklyn Public Library							CONTRACT #: **Contract 1 – GENERAL CONSTRUCTION** TRADE: SHOP DRAWING LOG SHEET #								
SPEC. SECT. #	DESCRIPTION	COORD. WITH CONTR.	SUBMITTAL			SUB. DATE	REQ'D DEL.	FABRIC. TIME	SUBMISSIONS								
			SHOP DWG.	SAMPLE	CAT. CUTS				REC'D	RET'D	ACTION	REC'D	RET'D	ACTION	REC'D	RET'D	ACTION
	Wire Connectors				X												
	Conductor Pulling Lubricant				X												
	Arc/Fireproofing Tape				X												
	Cable Ties				X												
26 0526	Grounding				X												
26 0529	Support Devices				X												
	Firestopping		X		X												
26 0533	Conduit				X												
	Fittings				X												
	Conduit Utilization Schedule		X														
	Boxes				X												
26 0553	Nameplates		X														
26 0923	Lighting Control Devices		X		X												
26 0943	Network Lighting Controls		X		X												
26 2726	Wiring Devices			X	X												
26 2819	Enclosed Switches				X												
26 5100	Interior Lighting		X		X												

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TABLE OF CONTENTS

CONTRACT NO. 1 – HVAC WORK

DIVISION 26 - ELECTRICAL

SECTION 01 91 00

GENERAL COMMISSIONING REQUIREMENT

PART 1 - GENERAL

1.1 SUMMARY

A. A Commissioning Agent (CxA), Dome-Tech, Inc., has been contracted to provide building system Commissioning (Cx) services for this project.

B. The intent of this Specification is to:

1. Familiarize the contractor with the Cx process and differences between a commissioned and "non-commissioned" project.

2. Specify what labor / tasks are required by the contractor (and subcontractors) to support the commissioning effort, so the contractor (and subcontractors) can properly estimate the costs for this work. This specification should not be treated as an isolated document and must be read in conjunction with other related specifications as identified in section 1.4 of this specification.

1.2 DESCRIPTION

A. Commissioning: Commissioning is a systematic process of ensuring that the building systems, including the mechanical, electrical, and plumbing systems, have been installed in the prescribed manner, are functionally checked and capable of being operated and maintained to perform with the design intent and have documentation to support proper installation and operation. The Commissioning Agent (CxA) shall provide the Owner with an unbiased, objective view of the system's installation, operation and performance. This process does not eliminate or reduce the responsibility of each system designer to provide a complete design or installing subcontractors to provide a finished product. Commissioning is intended to enhance the quality of each system installation, startup and transfer to beneficial use by the Owner.

B. Commissioning during the construction phase is intended to achieve the following specific objectives, according to the Contract Documents:

1. Verify that applicable equipment and systems are installed according to the design, contract specification, manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.

2. Ensure that the design and construction align with the owner's energy conservation goals through the implementation of energy conservation measures (ECMs) that were selected by the owner.

3. Verify and document proper performance of equipment and systems.

4. Verify that Operation & Maintenance documentation is complete and transferred to Owner.

5. Verify that the Owner's operating personnel are adequately trained to maintain and operate the equipment and systems.

6. Verify a contract is in place for a post occupancy review with O&M staff within 10 months after Substantial Completion.

C. The Commissioning process shall be a team effort and encompass, as well as coordinate, the traditionally separate functions of system documentation, system installation, equipment startup, control system calibration, testing, balancing and verification and performance checkouts.

D. The CxA will work closely with the construction team, cooperating on and coordinating all Cx activities with the CM/Owner's representative, Trade Contractors, subcontractors, manufacturers and equipment suppliers.

E. The Cx process shall not reduce the responsibility of the construction management group (CM/GC) to comply with the Contract Documents.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.

1.4 RELATED SPECIFICATION SECTIONS INCLUDE

A. Division 22 : Plumbing specifications

B. Division 23: HVAC specifications

C. Division 26: Electrical Specifications

1.5 DEFINITIONS

A. The following is a list of definitions utilized with this specification. Other definitions outlined in the General Conditions, Supplementary Conditions, Technical Specifications or other Contract Documents shall remain in effect.

1. Acceptance Phase: Phase of construction after installation completion, startup and initial checkout when functional performance tests, operation and maintenance documentation review and training occur.

2. Approval: Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.

3. Architect/Engineer (A/E): The consultants who comprise the design team, generally the Architect, the HVAC Mechanical Engineer, the Plumbing Engineer and the Electrical Engineer.

4. Basis of Design (BOD): A document that records the concepts, calculations, decisions and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process. The Designer of Record produces this document.

5. Check Sheets: The step by step process that must be executed to fulfill the test requirements. The CxA shall develop the check sheets.

6. Client Agency: The department, division, or other part of the New York City municipal structure that occupies and operates the building in which this project is to be constructed. The Client Agency and DCAS are considered the Owner for the purposes of the commissioning process.

7. Commissioning Agent (CxA): The Commissioning Agent is an independent authority, not otherwise associated with the A/E team members, the CM or Trade Contractor. The CxA directs and coordinates day to day commissioning activities. The CxA does not take an project oversight role. The CxA developed the energy audit report in which the energy conservation measures are described.

8. Commissioning Plan (CxP): An overall plan developed by the CxA before or after bidding that provides the structure, schedule and coordination planning for the Cx process.

9. Construction Manager (CM): The Construction Manager or their authorized representative appointed by the owner.

10. Pre-functional / Installation Checklists (ICs): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Subcontractors. Installation checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension correct, oil levels, labels affixed, gages in place, sensors calibrated, etc.). The word installation refers to pre functional testing. Installation checklists augment and are combined with the manufacturer's startup checklist.

11. Contract Documents: The documents binding all concerned involved in the construction of this Project (Drawings, Specifications, Bulletins, Change Orders, Amendments, other Contracts, Commissioning plans, etc.) as defined in the General Conditions of the Contract.

12. Control System: The central building management control system. (BAS or BMS system)

13. Data Logging: Monitoring flows, currents, status, pressures, etc. of equipment, using standalone data loggers separate from the control system.

14. Department of Citywide Administrative Services (DCAS): DCAS is the department of the New York City municipal government that is tasked with implementing ECMs in order to comply with New York City Local Law 87 of 2009. DCAS provides the funding for this project. DCAS and the Client Agency are considered the Owner for the purposes of the commissioning process.

15. Design Intent (DI): An explanation of the ideas, concepts and criteria that are considered to be very important to the Owner. It is initially the outcome of the programming and conceptual design phases. The design intent is developed from the OPR and BOD. Descriptions in the energy audit report of the selected ECMs shall be considered part of the Design Intent.

16. Energy Audit: An energy audit, as defined in NYC Local Law 87 of the 2009, is a "systematic process of identifying and developing modifications and improvements of the base building systems, including but not limited to alterations of such systems and the installation of new equipment, insulation or other generally recognized energy efficiency technologies to optimize energy performance of the building and achieve energy savings." An energy audit of the facility was performed by CxA and resulted in a final energy audit report dated December 29, 2010.

17. Energy Conservation Measure (ECM): An ECM is an action that can be taken or project that can be implemented to achieve energy savings. ECMs include equipment upgrades and modifications and installation of new equipment including new controls. ECMs were recommended in the energy audit report. Several of these ECMs were selected by the Owner for implementation. The descriptions of these ECMs in the energy audit report form part of the Design Intent and Owner's Project Requirements.

18. Functional Performance Checks or Functional Checks (FCs): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation, and components are verified to be responding as the sequences state. Traditional air or water test and balancing is not functional testing, in the commissioning sense of the word. The Commissioning Authority develops the functional test procedures in a sequential written form. The FCs are generally developed from the approved sequence of operation and control logic in conformance to owner's project requirement and contract documents. CxA coordinates, oversees, witnesses and documents the actual testing, which is usually performed by the installing Contractor or vendor. Function tests are performed after installation checklists and startup are complete.

19. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

20. Installing Contractor / Subcontractor: Contractor / Subcontractor who installs specific equipment and / or systems.

21. Issue: A condition in the installation or function of a component, piece of equipment or system that is not in compliance or conformance with the Contract Documents.

22. Issues Database: A formal and ongoing record of problems, deficiencies or concerns – and their resolution – that have been raised by members of the Commissioning Team during the course of Cx. 'Issues database' is the primary tracking tool to address all commissioning issues by the concerned parties. All issues must be addressed / closed by the concerned parties before close-out.

23. Local Law 87 of 2009: The City of New York Local Law 87 of 2009 (LL 87) requires energy audits and retro-commissioning of certain buildings and the implementation of ECMs at certain city-owned buildings. LL 87 is part of the administrative code of the City of New York.

24. Manual Test: A test using handheld instruments, immediate control system readouts or direct observation to verify performance (as opposed to analyzing monitored data taken over time to make the "observation").

25. Master Equipment List (MEL): A complete listing of all commissioned building equipment, including detail such as make, model, etc., that is taken from submittals and is the basis from which check sheets will be generated.

26. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

27. Overwritten Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value to verify economizer operation). See also "Simulated Signal".

28. Owner: For the purposes of the commissioning process, the owner is the Client Agency and DCAS.

29. Owner Contracted Tests: Tests paid for by the Owner outside of the CM's Contract and for which the CxA does not provide oversight. These tests will not be repeated during functional tests if properly documented.

30. Owner's Project Requirements (OPR): The Owner's Project Requirements is the documentation of the primary thought processes and assumptions behind design decisions that were made to develop the Basis of Design (BOD and meet the design intent. The OPR describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the design intent may be included. Descriptions in the energy audit report of the selected ECMs shall be considered part of the OPR.

31. Phased Commissioning: For projects that are anticipated to be completed in phases, commissioning that is completed in stages due to the size of the structure or other scheduling issues to minimize total construction time.

32. Sampling: Functional testing for a percent / fraction of the total number of identical or near identical pieces of equipment.

33. Seasonal Performance Tests: Functional tests that are deferred until or performed again when the system(s) will experience climate conditions closer to their design conditions.

34. Startup: The initial starting or activating of equipment, including executing construction checklists.

35. Subcontractors: The subcontractors that provide building components and systems under the General Construction Contractor.

36. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested on any given piece of equipment or any given system (integrated and/or stand-alone). The test requirements are not the detailed test procedures. The test requirements for each system are specified in the respective section of the Contract Documents.

37. Testing, Adjust, Balance (TAB): Primary work is setting up the system flows and pressures as specified whereas functional testing is verifying that which has already been set up.

38. Trending: Monitoring using the building control system.

39. Vendor: Supplier of equipment.

1.6 REFERENCES

A. General: Comply with the applicable provisions and recommendations of references, except as modified by governing codes and by the Contract Documents. Where a recommendation or suggestion occurs in the references, such recommendation or suggestion shall be considered mandatory. In the event of conflict between references, this specification or within themselves, the more stringent standard or requirement shall govern.

1. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): "ASHRAE Guideline 1.1-2007 ASHRAE Guideline HVAC&R Technical Requirements for The Commissioning Process.

2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): "ASHRAE Guideline 0-2005 ASHRAE Guideline 'The Commissioning Process".

1.7 COMMISSIONING TEAM

A. Commissioning Team: The members of the commissioning team consist of the CxA, Owner, CM, the Architect and MEP Engineers, the Mechanical Trade Contractor, the Electrical Trade Contractor, the TAB representative (if independently retained), the Temperature Controls Contractor, as well as any other installing subcontractors or suppliers of equipment. The Owner's building or plant operator / engineer shall also be a member of the commissioning team.

B. Members Appointed by CM: Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers and specialists deemed appropriate by the CxA.

C. Members Appointed by Owner:

1. Commissioning Agent (CxA): The designated person, company or entity that plans, schedules and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.

2. Construction Manager (CM)

3. Representatives of the facility user and operation and maintenance personnel.

4. Architect and engineering design professionals.

1.8 OWNER'S RESPONSIBILITIES

A. Select ECMs for implementation. These ECMs were selected prior to the design phase. They form part of the OPR & BOD.

B. Provide the OPR & BOD documentation to the CxA and design team members for use in developing the commissioning plan; systems manual; operation and maintenance training plan; and testing plans and checklists.

C. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:

1. Coordination meetings.

2. Training in operation and maintenance of systems, subsystems and equipment.

3. Testing meetings.

4. Demonstration of operation of systems, subsystems and equipment.

D. Provide the approved Contract Documents to the CxA andCMfor use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.9 CONSTRUCTION MANAGER'S (CM) RESPONSIBILITIES

A. Provide utility services and any consumable required for the commissioning process.

B. The CM shall assign representatives with expertise and authority to act on behalf of the CM and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in design and construction phase coordination meetings.

2. Insert Cx requirements into the master schedule.

3. Participate in maintenance orientation and inspection.

4. Participate in operation and maintenance training sessions.

5. Participate in final review at acceptance meeting.

6. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls. Notify the CxA when issues have been resolved.

7. Schedule testing, training, and provide a minimum of 48 hours' notice to CxA for witnessing the testing.

8. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

9. Review and approve final commissioning documentation.

10. For enhanced commissioning, forward submittals to CxA for comment.

1.10 GC/SUB CONTRACTOR'S RESPONSIBILITIES

A. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in construction phase coordination meetings.

2. Demonstrate all sequences to CxA.

3. Participate in maintenance orientation and inspection.

4. Participate in procedures meeting for testing.

5. Execute Installation check sheets.

6. Support functional testing with qualified technicians.

7. Respond to Cx Issues Database within seven days of publication of issue.

8. Participate in final review at acceptance meeting.

9. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.

10. Provide information to the CxA for developing construction phase commissioning plan.

11. Co-ordinate / Conduct training sessions for Owner's operation and maintenance personnel.

12. Provide updated Project Record Documents to the CxA on a daily / weekly basis.

13. Gather and submit operation and maintenance data for systems, subsystems and equipment to the CxA 45 days after acceptance.

14. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems and equipment.

1.11 COMMISSIONING AGENT'S (CxA) RESPONSIBILITIES

A. The functions and responsibility of the CxA shall include:

1. Organization and leadership of the Commissioning team with primary responsibility to inform the Owner and CM on the status, integration, and performance of systems within the facility.

2. Perform the energy audit and produce the energy.

3. Ensure that the intent of the selected ECMs are achieved through the design and construction process.

4. Preparation of construction-phase commissioning plan and collaboration with CM and appropriate subcontractors and suppliers to develop testing and inspection procedures including design changes and scheduled commissioning activities coordinated with overall Project schedule.

5. Scheduling: The CxA shall work with the CM according to established protocols to schedule the commissioning activities. The CxA shall provide INPUTS to the CM for scheduling commissioning activities. The CM shall integrate all commissioning activities into the master schedule. All parties shall address scheduling problems and make necessary notifications in a timely manner to expedite the commissioning process.

6. Identification of commissioning team member responsibilities by name, firm and trade specialty for performance of each commissioning task.

7. Convene commissioning team meetings for the purpose of coordination, communication and conflict resolution; discuss progress of commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists and notifying participants. The CxA shall prepare and distribute minutes to commissioning team members and attendees.

8. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; testing, adjusting and balancing work; and Project completion.

9. Observe and inspect construction and report progress and deficiencies. In addition to compliance with the OPR, BOD and Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.

10. Observation of Tests: CxA shall prepare, schedule (with the CM), coordinate, direct, witness and document Project specific tests, inspections, checkout and startup procedures (performed by the contractors) as required to ensure equipment and system installation, operation and performance meets the design intent. The CxA shall provide technical inputs to oversee and verify the correction of open issues found during the commissioning process.

11. Compile test data, inspection reports and certificates and include them in the commissioning report.

12. Acceptance: The CxA shall recommend acceptance to the Owner for each component and system for start of the warranty period.

13. Review Project Record Documents for accuracy. Request revisions from CM to achieve accuracy.

14. Review and comment on operation and maintenance documentation and systems manual outline for compliance with the OPR, BOD and Contract Documents.

15. Review subcontractor submitted O&M & training documentation.

16. Prepare commissioning reports.

17. Assembly of the final commissioning documentation.

18. For enhanced commissioning, review and comment on submittals from CM for compliance with the OPR, BOD, Contract Documents and construction phase commissioning plan. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the OPR and BOD.

B. The CxA is referred to as an independent contractor in this Section and shall work under a separate contract directly for the Owner. The CxA shall not be financially associated with any of the work of the contractors or subcontractors on this project to avoid potential conflicts of interest.

1.12 COMMISSIONING DOCUMENTATION (the definitions are already covered under 1.5)

A. Owner's Project Requirements.

B. Basis of Design (BOD)

C. Commissioning Plan: The commissioning plan is a living document that will evolve over the course of the project and ultimately include:

1. Description of the organization, layout and content of commissioning documentation and a detailed description of documents to be provided along with identification of responsible parties.

2. Identification of systems and equipment to be commissioned.

3. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.

4. Identification of items that must be completed before the next operation can proceed.

5. Description of responsibilities of commissioning team members.

6. Description of observations to be made.

7. Schedule for commissioning activities

D. Pre-functional check / Installation Checks (IC):

E. Functional Checks (FC): The end goal is that all associated equipment and components are verified simultaneously to ensure that all elements

operate as per the contract documents. Each checklist, regardless of system, subsystem or equipment being tested, shall include, but not limited to, the following:

1. Name and tag of tested item.
2. Date of test.
3. Indication of whether the record is for a first test or retest following correction of a problem or issue.
4. Dated signatures of the person performing test and of the witness if applicable.
5. Deficiencies.
6. Issues, if any, generated as the result of test in the note section

F. Test and Inspection Reports: CxA shall record test data, observations and measurements on test checklists.

G. Corrective Action Documents: CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.

H. Issues Database: CxA shall prepare and maintain an issues database that describes design, installation and performance issues that are at variance with the OPR, BOD and Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.

1. Documenting Issue Resolution:
    a. Log date correction is completed or the issue is resolved.
    b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue if any.
    c. Identify changes to the Owner's Project Requirements, Basis of Design, or Contract Documents that may require action.
    d. State that correction was completed and system, subsystem and equipment is ready for retest if applicable.

e. Identify person(s) who corrected or resolved the issue.

f. Identify person(s) documenting the issue resolution.

I. Commissioning Report: CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems and equipment. The commissioning report shall indicate whether systems, subsystems and equipment have been completed and are performing according to the Owner's Project Requirements, Basis of Design and Contract Documents. The commissioning report shall include the following:

1. Lists and explanations of substitutions; compromises; variances in the Owner's Project Requirements, Basis of Design and Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.

2. Owner's Project Requirements and Basis of Design documentation.

3. Commissioning plan.

4. Corrective modification documentation.

5. Issues database.

6. Completed Installation and functional check sheets.

7. Listing of any seasonal test(s) remaining and a schedule for their completion.

1.13 SUBMITTALS

A. Commissioning Plans: Submit to Owner and Architect

B. Testing: Submit to Owner and Architect

1. Functional Checklists and Report Forms: CxA shall submit Prefunctional and functional test procedures to CM, A/E for review, comment, and distribution.

2. Test and Inspection Reports: Submit for Owner and Architect's information. CxA shall submit test and inspection reports.

C. Corrective Action Documents: CxA shall submit corrective action documents in the form of 'Issues Log'

1.14 SYSTEMS TO BE COMMISSIONED

A. All parties associated with the design, installation and / or testing of these systems shall comply with commissioning requirements specified in this section, in the individual Division commissioning sections and in the Commissioning Plan.

B. Systems to be commissioned shall include:

1. HVAC units

2. HVAC Controls

3. System Testing and Balancing

4. Electrical distribution

5. Lighting and controls

C. Systems, equipment, controls, and sequences of operation to be commissioned are only those installed as part of this design and construction project. Existing equipment on site will need to be operated as part of the testing procedures.

1.15 COORDINATION

A. The Owner/CM will furnish copies of all construction documents, addenda, change orders and appropriate approved submittals and shop drawings to the CxA.

B. The CxA shall coordinate directly with the Owner / CM on the project specific to their responsibilities and contractual obligations. If the contractor is a subcontractor to another contractor, the CxA shall disseminate written information to all responsible parties relative to the nature and extent of the communication.

C. The CxA is primarily responsible to the Owner, and therefore shall regularly apprise the Owner of progress, pending problems and / or disputes, as well as provide regular status reports on progress with each system.

D. The CxA shall coordinate the schedule of commissioning activities with the construction schedule. It is possible that some procedures will be completed before the entire mechanical or electrical system is completed.

1.16 SCHEDULE

A. Commissioning of systems shall proceed per the criteria established with activities to be performed on a timely basis. The CxA shall be available with a 48 hour notice to respond promptly and avoid construction delays.

B. Startup and testing of systems may proceed prior to final completion of systems to expedite progress. However, the CxA shall not schedule testing and checkout services that are the primary responsibility of the contractor / vendor in advance of their testing and checkout.

C. Open issues observed shall be addressed immediately, responsible parties notified, and corrective actions coordinated in a timely manner.

D. Construction schedules and scheduling are the responsibility of the CM. The CxA shall provide commissioning scheduling information to the Owner's Representative and CM for review and planning activities.

1.17 OTHER REQUIREMENTS

A. Commissioning requires support from the CM, GCC, Trade Contractors and subcontractors. The commissioning process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner.

B. Commissioning requirements in this section should not be confused with "commissioning" requirements at the end of various technical specification sections. Those requirements that are at the end of various technical specification sections are part of the quality control procedures and are to be completed by the respective contractor before the commissioning process begins.

C. Refer to the Commissioning plan submitted by the CxA for a detailed description of all commissioning requirements and responsibilities for all involved parties including: Owner, Owner's Representative, Architect, Design Engineer, CM, GCC, Trade Contractors, and Subcontractors.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All industry standard test equipment required for performing the specified tests shall be provided by the appropriate party responsible for the testing. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer.

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents, shall be included in the base bid price to the Trade Contractor and left on site, except for standalone data logging equipment that may be used by the CxA.

C. If data logging equipment is required, the loggers and the necessary software shall be provided by the CxA but not become the property of the Owner.

D. Any portable or handheld setup / calibration devices required to initialize the control system shall be made available by the control vendor (at no additional cost) to the CxA.

E. The instrumentation used in the commissioning process shall comply with the following:

1. Be of sufficient quality and accuracy to test and / or measure system performance within the tolerances required.

2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument.

3. Be maintained in good repair and operating condition throughout use duration on this project.

4. Be immediately recalibrated or repaired if dropped and / or damaged in any way during use on this project.

PART 3 - EXECUTION

3.1 COMMISSIONING PLAN AND SCHEDULE

A. The CxA shall develop and submit a schedule identifying the commissioned system and commissioning process which is integrated by the CM with the construction schedule. The required work by all team members (CxA, Trade Contractors and the Owner) shall be included. Overlay with the construction schedule, and include time for test and balance, Installation checkouts, as well as Functional testing.

B. Commissioning Plan: The Commissioning Plan provides guidance in the execution of the Commissioning process. Just after the initial Commissioning kickoff meeting, the CxA will update the plan, which is then considered the "final" plan (though it will be a living document that continues to evolve and expand as the project progresses). The Specifications will take precedence over the Commissioning Plan.

3.2 COMMISSIONING PROCESS

A. Commissioning Process: The following provides an overview of the Commissioning tasks during design and construction and the general order in which they occur.

1. Energy Audit Phase

   a. An energy audit was performed by the CxA prior to the design phase.

   b. Several ECMs identified in the energy audit report were selected by the Owner for implementation. The energy audit report that includes descriptions of these selected ECMs was provided to the design team at the beginning of the design phase.

2. Design Phase

   a. Commissioning during the design phase begins with a design kickoff meeting in which the selected ECMs are described by the CxA.

   b. Commissioning shall include the design review (usually 75% DD, 75% CD and 100% CD), provide comments from commissioning perspective.

3. Construction Phase

   a. Commissioning during construction begins with a Commissioning orientation meeting, conducted by the CxA, where the Commissioning process is reviewed with the other Commissioning team members.

   b. Additional meetings may be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate and schedule future activities and resolve open issues.

   c. Equipment documentation for commissioned systems / equipment is submitted to the CxA for review, concurrent with normal submittals, including detailed startup procedures.

   d. The CxA works with the CM, Trade Contractors and subcontractors in developing IC/FC documentation formats.

e. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with Installation checklists being completed before Functional Performance Checklists.

f. The Subs, with guidance from the CxA, execute and document the Installation checklists and perform startup and initial checkout. The CxA documents that the checklists and startup were completed according to the approved plans. This may include the CxA witnessing portions of the startup of selected equipment and spot checking the Installation check sheets.

g. The CxA develops specific equipment and system Functional check sheets. The Subs receive copies of the procedures. The CxA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

h. The Functional and/or system performance check sheets are executed by the subs, witnessed by the CxA.

i. Items of non-compliance in material, installation or setup are corrected and the system rechecked not to exceed one additional time.

j. The CxA reviews the Operation & Maintenance documentation for completeness.

k. Commissioning is completed before Substantial Completion.

l. The CxA reviews the training documentation. The training schedules are provided by the Subs and CxA verifies that training was completed.

m. Deferred testing / checkouts are conducted, as specified or required.

3.3 INSTALLATION / FUNCTIONAL PERFORMANCE

A. Personnel experienced in the technical aspects of each system to be commissioned shall develop and document the commissioning procedure to be used. Include a performance checklist and performance checkout data sheets for each system based on actual system configuration. These

procedures shall be reviewed by the Owner for technical depth, clarity of documentation and completeness. Special emphasis shall be placed on checkout procedures that shall conclusively determine actual system performance and compliance with the design intent.

B. The majority of mechanical equipment requires safety devices to stop and / or prevent equipment operation unless minimum safety standards or conditions are met. These may include adequate oil pressure, proof-of-flow, non-freezing conditions, maximum static pressure, maximum head pressure, etc. The party responsible for checkout procedures shall observe the actual performance of safety shutoffs in a real or closely simulated condition of failure.

C. Systems may include safety devices and components that control a variety of equipment operating as a system. Interlocks may be hard-wired or operate from software. The party responsible for commissioning checkout procedures shall verify operation of these interlocks.

D. The CxA shall determine the acceptance procedures for each system within disciplines. The acceptance procedures shall incorporate the commissioning standards and successful testing results as referred to throughout specifications.

As guidance for HVAC system acceptance, the following should be considered

1. The temperature control system shall have all I/O points individually verified for proper function, calibration, and operation. The CxA shall review proposed testing procedures and report formats, and observe sufficient field testing to confirm that all I/O points have been properly tested.

2. All control sequence of operation strategies, alarm generation and reporting shall also be reviewed and proper operation verified by the CM and Trade Contractors with oversight by the CxA.

3. The central work station graphics, point assignments, alarm messages, and logging functions shall be verified.

E. The appropriate contractor and vendor(s) shall be informed of what tests are to be performed and the expected results. Whereas some test results and interpretations may not become evident until the actual tests are performed, all parties shall have a reasonable understanding of the requirements. The commissioning plan shall address those requirements and be distributed to all parties involved with that particular system.

F. Acceptance procedures shall confirm the performance of systems to the extent of the design intent. When a system is recommended to be accepted, the Owner shall be assured that the system is complete, works as intended, is correctly documented, and operator training has been performed.

3.4 FUNCTIONAL PERFORMANCE TESTS – OBSERVATION / WITNESS

A. The Functional Performance tests shall be performed by the contractors and vendors with oversight by the CxA. The CxA shall witness, verify and document these tests.

B. Check sheets shall be completed comprehensively and to the extent necessary to enable the CxA to assure the Owner that the systems do perform per the owner's requirement.

3.5 SOFTWARE DOCUMENTATION REVIEW

A. Review software documentation for all DDC control systems. This includes review of vendor documentation and specific software routines applied to this project. Discrepancies in sequences shall be reported and coordinated to provide the Owner with the most appropriate, simple and straightforward approach to software routines.

3.6 TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that commissioned systems, subsystems and equipment have been completed, calibrated and started; are operating according to the OPR, BOD and Contract Documents; and that Certificates of Readiness are signed and submitted.

2. Certify that all relevant instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BOD and Contract Documents; and that pretest set points have been recorded.

3. Certify that testing, adjusting and balancing (TAB) procedures have been completed, and that TAB report have been submitted, discrepancies corrected and corrective work approved.

4. Test systems and intersystem performance after approval of testing check sheets for systems, subsystems and equipment.

5. Set systems, subsystems and equipment to operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power and alarm conditions).

6. Verify each mode of operation once it is operating in a steady state condition.

7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable or failed. Repeat this test for each operating cycle that applies to system being tested.

8. Check safety cutouts, alarms and interlocks with smoke control and life safety systems during each mode of operation when applicable.

9. Annotate checklist or data sheet when a deficiency is observed.

10. Verify equipment interface with monitoring and control system and the TAB

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, Operational modes generally include the following:

1. Occupied and unoccupied.

2. Warm up and cool down.

3. Economizer cycle.

4. Emergency power supply.

5. Life safety and safety systems.

6. Smoke control.

7. Temporary upset of system operation.

8. Partial occupancy conditions.

3.7 TESTING

A. Test systems and intersystem performance as per the test procedures. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

2. Alter setpoints when simulating conditions is not practical and when written approval is received from CxA.

3. If a test is failed for reason and retesting is required, the concerned agency (contractor, equipment manufacturer) shall provide the service on an agreed upon date at no cost to the owner.

4. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

3.8 COST OF RETESTING

A. The cost for the GC/trade contractor to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs.

B. For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply: The CxA will direct the retesting of the equipment once at no charge to the owner for their time.

C. The time for the CxA to direct any retesting required because a specific prefunctional checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, the cost will be reimbursed by the contractor. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor or GC.

3.9 OPERATION & MAINTENANCE MANUALS

A. The CxA shall review the Operation & Maintenance manuals provided by Trade Contractors or subcontractors. The review process shall verify that Operation & Maintenance instructions meet specifications and are included for all equipment furnished by the Trade Contractor.

B. Published literature shall be specifically oriented to the provided equipment, indicating required operation and maintenance procedures, parts lists, assembly / disassembly diagrams and related information.

C. The Trade Contractor shall incorporate the standard technical literature into system specific formats for this facility as designed and as actually installed. The resulting Operation & Maintenance information shall be system specific, concise, to the point and tailored specifically to this facility. The CxA shall review and edit these documents as necessary for final corrections by the Trade Contractor.

D. The Operation & Maintenance Manual review and coordination efforts shall be completed prior to Owner training sessions, as these documents are to be utilized in the training sessions.

3.10 RECOMMISSIONING or SYSTEMS MANUAL

A. Per Contract Documents, the CxA shall prepare and deliver the documents that are required to periodically "tune up" building systems. The contractors will confirm the proper documents are onsite and readily available. Typically, the manual includes the following:

1. As built sequences of operation for all equipment and control drawings installed as part of this project.

2. List of programmed operation schedules and frequency for their review.

3. Engineering narratives for all energy and water saving methods and equipment (supplied by the Engineer of Record).

4. Narrative of seasonal operational issues, including seasonal startup and shutdown, manual and restart operation procedures, recommendations regarding seasonal operational issues that affect energy use.

5. List of all user adjustable setpoints and reset schedules with a brief discussion of the purpose of each and the range of reasonable adjustments with energy implications.

6. Recommendations for recalibration frequency for sensors and actuators.

7. Recommendations for user adjustable setpoints and frequency of checking.

8. Recommended frequency of Recommissioning.

9. List of diagnostic tools and directions for use.

3.11 TRAINING

A. The CM shall schedule and coordinate training sessions for the Owner's staff for each system. Training shall be held per Contract Documents, along with the appropriate schematics, handouts and visual / audio training aids onsite with equipment.

B. The appropriate installing Trade Contractor shall provide training on all the major systems per specifications, including peculiarities specific to this project.

C. The equipment vendors shall provide training on the specifics of each major equipment item including philosophy, troubleshooting and repair techniques.

D. The automatic control and fire alarm vendors shall provide training on the control system and fire alarm system per their specification section.

E. For additional prescription pertinent to training, refer to other specific divisions for training requirements.

3.12 WARRANTY REVIEW / SEASONAL TESTING

A. The CxA may return upon the start of the new season (cooling or heating) after project completion to conduct performance tests that could not be performed due to ambient conditions. The seasonal testing will only be performed if unsuitable loads / conditions were unavailable during the performance testing stages (in other words; the requirement for testing is warranted).

B. If agreed upon by Owner, Seasonal Testing can also be used for the Warranty Review. During which the CxA will interview the occupants, maintenance staff, review the operation of the building, provide recommendations for installation and operational problems and document warranty and operational issues in the issues database.

3.13 RECORD DRAWINGS

A. The CxA shall review the as built contract documents to verify completeness of the document. Discrepancies noted shall be corrected by the appropriate party.

3.14 EXCLUSIONS

A. Responsibility for construction means and methods: The CxA is not responsible for construction means & methods, job safety or any construction management functions on the job site.

B. Hands on work by the CxA: The Trade Contractors shall provide all services requiring tools or the use of tools to startup, test, adjust or otherwise bring equipment and systems into a fully operational state. The CxA shall coordinate and observe these procedures (and may make minor adjustments) but shall not perform any construction, field or technician services other than verification of testing, adjusting, balancing and control functions.

END OF SECTION

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SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

C. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to the City of New York that may be uncovered during demolition remain the property of the City of New York.

1. Carefully salvage in a manner to prevent damage and promptly return to the City of New York.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for dust control and for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure the City of New York's -site operations are uninterrupted.

2. Interruption of utility services. Indicate how long utility services will be interrupted.

3. Coordination for shutoff, capping, and continuation of utility services.

4. Use of elevator and stairs.

5. Coordination of the City of New York's continuing occupancy of existing building.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to the City of New York prior to start of demolition.

E. Predemolition Photographs or Video: Submit before Work begins.

F. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.7 FIELD CONDITIONS

A. The City of New York will continuously occupy the building during normal operating hours. Conduct selective demolition so Library's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by the City of New York as far as practical.

C. Notify Commissioner of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: Hazardous materials are present in the building and structures to be selectively demolished as indicated on asbestos abatement drawings in the contract documents. Examine drawings and specifications to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified in the Contract Documents.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Commissioner.

D. Perform engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

E. Survey of Existing Conditions: Record existing conditions by use preconstruction photographs and preconstruction videotapes.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."

2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Inform the City of New York and arrange to shut off indicated utilities with utility companies.

2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Disconnect, demolish, and remove electrical and HVAC systems, equipment, and components indicated to be removed.

   a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

   b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

   c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

   d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

   e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

   f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

   g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.3 PREPARATION

A. Refer to Section 01 50 00 – Temporary Facilities, Services, and Controls.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Work in Historic Areas:

1. Refer to Section 01 55 91 – Historic Treatment Procedures

C. Clean and repair items to functional condition adequate for intended reuse.

1. Pack or crate items after cleaning and repairing. Identify contents of containers.

2. Protect items from damage during transport and storage.

3. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Commissioner, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

E. Gypsum Board:

1. Demolish in small sections. Neatly trim openings to dimensions indicated.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the City of New York's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Remove debris from elevated portions of building by service elevator that will convey debris to grade level in a controlled descent.

4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Burning of demolished materials will not be permitted.

C. Disposal: Transport demolished materials off the City of New York's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Existing Items to Be Removed and Reinstalled: Acoustical tiles.

END OF SECTION

SECTION 028013 – GENERAL CONTRACTOR WORK

ALLOWANCE FOR INCIDENTAL ASBESTOS ABATEMENT

1.01 SCOPE FOR ASBESTOS ABATEMENT WORK

A. The "General Conditions" apply to the work of this Section.

B. The Asbestos abatement contractor shall remove asbestos containing materials as needed to perform the other work of this Contract when discovered during the course of work. When required, the Asbestos abatement contractor shall replace the ACM with non-asbestos containing materials. An allowance of **$15,000.00** for the **General Contractor** is herein established for this incidental work when so ordered and authorized by the Commissioner.

C. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE APPLICABLE PROVISIONS OF THE RULES AND REGULATIONS OF THE ASBESTOS CONTROL PROGRAM AS PROMULGATED BY TITLE 15 CHAPTER I OF RCNY AND NEW YORK STATE DEPARTMENT OF LABOR INDUSTRIAL CODE RULE 56 CITED AS 12 NYCRR, PART 56 WHICHEVER IS MORE STRINGENT AS PER LATEST AMENDMENTS TO THESE LAWS AND AS MODIFIED HEREIN BY THESE SPECIFICATIONS.

D. ALL DISPOSAL OF ASBESTOS CONTAMINATED MATERIAL SHALL BE PER LOCAL LAW 70/85.

E. THE ASBESTOS ABATEMENT CONTRACTOR'S ATTENTION IS DIRECTED TO THE FACT THAT CERTAIN METHODS OF ASBESTOS ABATEMENT ARE PROTECTED BY PATENTS. TO DATE, PATENTS HAVE BEEN ISSUED WITH RESPECT TO "NEGATIVE PRESSURE ENCLOSURE" OR "NEGATIVE-AIR" OR "REDUCED PRESSURE" AND "GLOVE BAG".

F. THE ASBESTOS ABATEMENT CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR AND SHALL HOLD THE DEPARTMENT OF DESIGN AND CONSTRUCTION AND THE CITY HARMLESS FROM ANY AND ALL DAMAGES, LOSSES AND EXPENSES RESULTING FROM ANY INFRINGEMENT BY THE ASBESTOS ABATEMENT CONTRACTOR OF ANY PATENT, INCLUDING BUT NOT LIMITED TO THE PATENTS DESCRIBED ABOVE, USED BY THE ASBESTOS ABATEMENT CONTRACTOR DURING PERFORMANCE OF THIS AGREEMENT.

G. "Asbestos" shall mean any hydrated mineral silicate separable into commercially usable fibers, including but not limited to chrysotile (serpentine), amosite (cumingtonite-grunerite), crocidolite (riebeckite), tremolite, anthrophyllite and actinolite.

H. Prior to starting, the Asbestos abatement contractor must notify the Commissioner of the Department of Design and Construction if he/she anticipates any difficulty in performing the Work as required by these Specifications. The Asbestos abatement contractor is responsible to prepare and submit all filings, notifications, etc. required by all City, State and Federal regulatory agencies having jurisdiction.

The Asbestos abatement contractor is responsible for submitting the Asbestos Project Notification Form (ACP-7 Form) to the Department of Environmental Protection, Asbestos Control Program, as per Title 15, Chapter I of RCNY and to the NYSDOL as per Industrial Code Rule 56.

The Asbestos abatement contractor is responsible for preparing, and submitting Asbestos Variance Application (ACP-9). If a Variance is required, the Asbestos abatement contractor is responsible to retain a NYSDOL Asbestos Project Designer, as defined in Title 15, Chapter 1 of the RCNY to prepare and submit the required variance.

The General contractor is responsible for preparing and submitting an Asbestos Abatement Permit and/or Work Place Safety Plans (WPSP) that may be required for the completion of the Contract or incidental work. If such plans are required, the Asbestos abatement contractor is responsible to retain a NYSDOL Licensed Design Professional as defined in Title 15, Chapter 1 of the RCNY to prepare and submit the required plans.

The Asbestos abatement contractor is responsible for the submission of all required documents to the NYCDEP to acquire the appropriate Asbestos Project Conditional Closeout (ACP-20) and/or Asbestos Project Completion Forms (ACP-21) on a timely basis for the completion of the incidental work encountered under this contract.

The Asbestos abatement contractor will be required to attend an on-site job meeting with the Construction Project Manager prior to the start of work to examine conditions and plan the sequence of operations, etc.

The Asbestos abatement contractor shall have a NYSDOL/NYCDEP Asbestos Supervisor onsite to oversee the work and conduct a final visual inspection as required by both Title 15, Chapter 1 of the RCNY and NYSDOL Industrial Code Rule 56.

I. All work shall be done during regular working hours unless the Asbestos abatement contractor requests authorization to work in other then regular working hours and such authorization is granted by the Commissioner. (Regular work hours are those hours during which any given facility, in which work is to be done, is customarily open and functioning, normally between the hours of 8:00 A.M. and 4:00 P.M. Monday - Friday.) If such work schedule is authorized by the Commissioner, the work shall be done at no additional cost to the City.

J. The Commissioner may order that work be done in other than regular working hours as herein by defined and this order may require the Asbestos abatement contractor to pay premium or overtime wages to complete the work. If the Commissioner orders work in other than regular working hours, the Asbestos abatement contractor shall multiply the unit price for that portion of the work requiring premium wages by 1.50 when computing payment in accordance with Paragraph 1.09. All requests for premium payment must be supported by certified payroll sheets and field sheets approved by the Construction Project Manager.

1.02 QUALIFICATIONS OF ASBESTOS ABATEMENT CONTRACTOR

A. Requirements: The asbestos abatement contractor must demonstrate compliance with the special experience requirements set forth in subparagraphs (1) through (5) below. The asbestos abatement contractor must, submit documentation demonstrating compliance with all listed requirements. Such documentation shall include without limitation, all required licenses, certificates, and documentation.

1. The asbestos abatement contractor must, whether an individual, corporation, partnership, joint venture or other legal entity, must demonstrate for the three year period prior to the work, that it has been licensed by the New York State Department of Labor, as an "Asbestos abatement contractor".

2. The asbestos abatement contractor must, for the three year period prior to the work, have been in the business of providing asbestos abatement services as a routine part of its daily operations.

3. The asbestos abatement contractor proposing to do asbestos abatement work must be thoroughly experienced in such work and must provide evidence of having successfully performed and completed in a timely fashion at least five (5) asbestos abatement projects of similar size and complexity. The aggregate cost of these projects must be at least $250,000.00 in each of the three years.

4. For each project submitted to meet the experience requirements set forth above, the asbestos abatement contractor must submit the following information for the project; name and location of the project; name title and telephone number of the owner or the owner's representative who is familiar with the asbestos abatement contractor's work, brief description of the work completed as a prime or sub-asbestos abatement contractor; amount of contract or subcontract and the date of completion.

5. The asbestos abatement contractor must demonstrate that it has the financial resources, supervisory personnel and equipment necessary to carry out the work and to comply with the required performance schedule, taking into consideration other business commitments. The asbestos

abatement contractor must submit such documentation as may be required by the Department of Design and Construction to demonstrate that it has the requisite capacity to perform the required services of this contract.

B. Insurance Requirements: The asbestos abatement contractor must provide asbestos liability insurance in the following amount: 1 million dollars per occurrence, 2 million dollars aggregate (combined single limit). The City of New York shall be named as an additional insured on such insurance policy.

C. Throughout the specifications, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics thereof.

1.03 ASBESTOS ABATEMENT CONTRACTOR RESPONSIBILITIES

The Asbestos abatement contractor will visit the subject location within one (1) working day of notification to ascertain actual work required. If the project is identified as being "urgent", then work shall commence no later than 48 hours from the time of notification. In this event, the asbestos abatement contractor shall immediately notify when applicable EPA NESHAPS Coordinator, NYSDOL Asbestos Control Bureau and NYCDEP Asbestos Control Program of start of the work and file the necessary Asbestos Notifications and any applicable Variance Applications with the regulatory agencies cited above.

In the event that the project is not classified as "urgent" the Asbestos abatement contractor shall notify the EPA NESHAPS Coordinator, NYSDOL and NYCDEP by submitting the requisite asbestos project notification forms, postmarked 10 days before activity begins if 260 linear feet or more and/or 160 square feet or more of asbestos containing material will be disturbed.

The following information must be included in the notification:

A. Name and address of building City or operator;

B. Project description:

1. Size - square feet, number of linear feet, etc;

2. Age - date of construction and renovations (if known);

3. Use - i.e., office, school, industrial, etc.

4. Scope - repair, demolition, cleaning, etc.

C. Amount of asbestos involved in work and an explanation of techniques used to determine the amount;

D. Building location/address, including Block and Lot numbers;

E. Work schedule including the starting and completion dates;

F. Abatement methods to be employed;

G. Procedures for removal of asbestos-containing material;

H. Name, title and authority of governmental representative sponsoring project.

1.04 WORK INCLUDED IN UNIT PRICE

The Asbestos abatement contractor will be paid a basic unit price of **$25.00** per square feet for the removal and disposal of asbestos containing material and replacement of the same with non-asbestos containing materials.

Unit price shall include all costs necessary to do the work of this Contract, including but not limited to: labor, materials, equipment, utilities, disposal, insurance, overhead and profit.

1.05 AIR MONITORING – ASBESTOS ABATEMENT CONTRACTOR

A. "Air Sampling" shall mean the process of measuring the fiber content of a known volume of air collected during a specific period of time. The procedure utilized for asbestos follows the N1OSH Standard Analytical Method 7400 or the provisional transmission electron microscopy methods developed by the USEPA and/or National Institute of Standard and Technology which are utilized for lower detectability and specific fiber identification.

B. Air monitoring of Asbestos abatement contractor's personnel will be performed in conformance with OSHA requirements, (All costs associated with this work are deemed included in the unit price.).

C. Qualifications of Testing Laboratory:

The industrial hygiene laboratory shall be a current proficient participant in the American Industrial Hygiene Association (AIHA) PAT Program. The laboratory identification number shall be submitted and approved by the City. The laboratory shall be accredited by the AIHA and New York State Department of Health Environmental Laboratory Approval Program (ELAP).

Note: Work area air testing and analysis before, during and upon completion of work (clearance testing) will be performed by a Third Party Air Monitor under separate Contract with the City.

1.06 THIRD PARTY MONITORING AND LABORATORY

A. The NYCDDC, at its own expense, will employ the services of an independent Third Party Air Monitoring Firm and Laboratory. The Third Party Air Monitor will perform air sampling activities and project monitoring at the Work Site.

B. The Laboratory will perform analysis of air samples utilizing Phase Contrast Microscopy (PCM) and/or Transmission Electron Microscopy (TEM).

C. The Third Party Air Monitoring Firm and the designated Project Monitor shall have access to all areas of the asbestos removal project at all times and shall continuously inspect and monitor the performance of the Asbestos abatement contractor to verify that said performance complies with this Specification. The Third-Party Air Monitor shall be on site throughout the entire abatement operation.

D. The NYCDDC will be responsible for costs incurred with the Third Party Air Monitoring Firm and laboratory work. Any subsequent additional testing required due to limits exceeded during initial testing shall be paid for by the Asbestos abatement contractor.

1.07 PAYMENT REQUEST DOCUMENTATION

B. The following information shall be included for each payment request:

1. Description of work performed.
2. Linear footage and pipe sizes involved.
3. Square footage for boiler & breaching insulation removed.
4. Square footage of non pipe and boiler areas removed, patched, enclosed, sealed, or painted.
5. Square footage of encapsulation, sealing, patching, and painting involved.
6. Total cost associated with compliance with the assigned task.
7. Architectural, Electrical, HVAC, Plumbing, etc. work incidental to the Asbestos Abatement Work.
8. A certified copy (in form 4312-39) to the Comptroller or Financial Officer of the New York City to the effect that the financial statement is true.
9. A signed copy (in form 6506q-6) of certificate of compliance with non-discriminatory provisions of the Contract.

10. Attach a copy of valid workmen compensation insurance.

11. Valid asbestos insurance per occurrence.

12. General liability insurance when required.

C. Each payment request shall include a grand total for all work completed that billing period, the landfill waste manifests and a copy of waste transporter permit. The Department of Design and Construction will inspect the work performed, review the cost and approve or disapprove requests for payment.

D. EXPOSURE LOG: With this final payment, the Asbestos abatement contractor shall submit a listing of the names and social security numbers of all employees actively engaged in the abatement work of this Contract. This list shall include a summary showing each part of the abatement work in which the employee was engaged and the dates thereof.

1.08 QUANTITY CALCULATIONS

In order to determine the square footage involved for the various pipe sizes of pipe insulation that might be encountered, the following table is to be used.

PIPE INSULATION SIZE O.D.	PIPE SIZE O.D.	SQUARE FOOTAGE PER LINEAR FOOT
2-1/2"	1/2"	0.65
2-3/4"	3/4"	0.72
3"	1"	0.79
3-1/4"	1-1/4"	0.85
3-1/2"	1-1/2"	0.92
4"	2"	1.05
4-1/2"	2-1/2"	1.18
5"	3"	1.31
6"	3-1/4"	1.57
7"	3-1/2"	1.83
8"	4"	2.09
9"	5"	2.36
10"	6"	2.62
12"	8"	3.14
14"	10"	3.67
16"	12"	4.19
18"	14"	4.71

1.09 METHOD OF PAYMENT

Payment shall be made in accordance with Items A through R below. Payment shall be calculated based on the actual quantity of the item performed by the asbestos abatement contractor, times the unit price specified below. Credits may apply to certain times, as specified below.

A. **REMOVAL, DISPOSAL AND REPLACEMENT OF ASBESTOS CONTAINING PIPE INSULATION:** Actual linear footage, multiplied by the square footage factor listed for the respective pipe size in Section 1.08, multiplied by the unit price in Section 1.04.

EXAMPLE: 100 lin.ft. of 1/2" pipe and 100 lin.ft. of 6" pipe, including elbows, tees. Flanges, etc.

100 X 0.65 = 65 sq.ft. 65 x unit price = Payment

100 X 2.62 = 262 sq.ft. 262 x unit price = Payment

B. **REMOVAL, DISPOSAL AND REPLACEMENT OF BOILER INSULATION:** (all types including Silicate Block and including the removal/replacement of metal jacketing) Payment shall be made at 1.5 times the unit price per square foot.

EXAMPLE: Item B. removal and replacement of 1000 S.F. of boiler insulation (incl. Silicate block)

1000 S.F. X (1.5) X the Unit Price = Payment

C. **REMOVAL, DISPOSAL AND REPLACEMENT OF TANK INSULATION:** (all types including removal/replacement of metal jacketing) Payment shall be made at 1.5 times the unit price per square foot.

D. **REMOVAL, DISPOSAL AND REPLACEMENT OF BOILER UPTAKE, & BREACHING INSULATION:** (all types including stiffening angles and wire lath) Payment shall be made at 2.0 times the unit price per square foot.

E. **REMOVAL, DISPOSAL AND REPLACEMENT OF DUCT INSULATION:** Payment shall be made at 1.0 times the unit price per square foot.

F. **REMOVAL, DISPOSAL AND REPLACEMENT OF SOFT ASBESTOS CONTAINING MATERIAL:** (Including sprayed-on fire proofing and sound proofing) Payment shall be made at 1.0 times the unit price per square foot of surface area. Area of irregular surfaces must be calculated and confirmed with DDC representative.

G. **ACOUSTIC PLASTER REPAIR AND/OR ENCAPSULATION:** Payment shall be made at 0.5 times the unit price per square foot.

H. **PATCHING OR REPAIR** of items listed in A through F will be paid at 0.33 times the unit price per square foot.

I. **REMOVAL, DISPOSAL AND REPLACEMENT OF WATERPROOFING ASBESTOS CONTAINING MATERIAL:** (including friable and non-friable waterproofing material from interior and exterior walls, floors, foundations, penetrations, louvers, vents and openings other than windows, doors and skylights) Payment shall be made at 0.5 times the unit price per square foot.

J. **REMOVAL, DISPOSAL AND REPLACEMENT OF ASBESTOS CONTAINING ELECTRICAL WIRING INSULATION:** (including friable and non-friable wiring insulation) Payment shall be made at 0.33 times the unit price per square foot.

K. **PAINTING:** Payment shall be made at 0.05 times the unit price per square foot.

L. **REMOVAL AND DISPOSAL OF ASBESTOS-CONTAINING PLASTER:** from ceilings and walls, including any wire lath and disposal as asbestos containing waste. Payment shall be made at 0.80 times the unit price per square foot.

M. **REMOVAL AND DISPOSAL OF ASBESTOS-CONTAINING FLOOR TILES, CEILING TILES, TRANSITE PANELS:** (including any adhesive, glue, mastic and/or underlayment) and disposal as asbestos containing waste. Payment shall be made at 0.40 times the unit price per square foot. If multiple layers are discovered, each additional layer shall be paid at 0.20 times the unit price per square foot.

N. **ADDITIONAL CLEAN UP/HOUSEKEEPING OF WORK AREA:** (excluding pre-cleaning of work area required by regulations) HEPA vacuuming and wet cleaning of asbestos contaminated surface. Payment shall be made at 0.20 times the unit price per square foot. When GLOVE BAG is employed to remove ACM, cost of HEPA vacuuming and wet cleaning of floor area up to 3 feet on each side of glove-bag shall be included in unit price and no extra payment will be made.

O. **REMOVAL, DISPOSAL OF ASBESTOS-CONTAINING ROOFING MATERIAL:** including mastic, flashing and sealant compound and provide temporary asbestos-free roof covering consisting of one layer of rolled roofing paper sealed with asphaltic roofing compound. Payment shall be made at 0.8 times the unit price per square foot. Credit at a rate of 0.33 times the unit price will be taken for each square foot of temporary roof covering which the Asbestos abatement contractor is directed not to install.

P. **PICK-UP AND DISPOSAL OF GROSS DEBRIS:** (excluding any waste generated from abatement under Item A-R) at a rate of $150 per cubic yard for asbestos contaminated waste and $75 per cubic yard for non-asbestos contaminated waste. This cost includes all labor and material cost associated with work.

Q. **REMOVAL OF ASBESTOS-CONTAINING BRICK, BLOCK, MORTAR, CEMENT OR CONCRETE:** along with all surfacing materials including wire lath and/or other supporting structures and disposal as ACM waste. Payment shall be made at a rate of $25.00 per cubic foot of material removed.

R. **REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING WINDOW/DOOR CAULKING:** including friable and non-friable caulking, weather-stripping, glazing, sealants or other waterproofing materials applied to windows, doors, skylights, etc. Payment shall be made at the rate of $400.00 per opening regardless of size or configuration. This cost includes labor, consumable materials, set-up/breakdown, removal and disposal, as required.

Note 1: CREDIT: For items listed in A through F, a credit at a rate of 0.33 times the unit price, times the respective multiplier (for each item) will be taken for each square foot of insulation which the asbestos abatement contractor is not directed to reapply.

Note 2: MINIMUM PAYMENT: The minimum payment per call at any individual job sites or various job sites during the same day will be eight hundred dollars ($800.00).

Note 3: All payments shall be made as described in paragraph 1.09 herein.

Note 4: WORKING HIGHER THAN 12 FEET ABOVE FLOOR LEVEL OR WORK REQUIRING COMPLEX SCAFFOLDING OR CONSTRUCTION WORK PLATFORMS: Provisions are made in this Contract to compensate the Asbestos abatement contractor for work performed in locations that are difficult to access due to work at elevations that are significantly higher than the normal work level. The unit price for these items will be paid at 1.20 times the unit price described in Paragraphs 1.09, A through R for those portions of the work that are more than twelve (12) feet above the grade for that would be judged as the normal working level.

1.10 GUARANTEE

A. Work performed in compliance with each task shall be guaranteed for a period of one year from the date the completed work is accepted by the Department of Design and Construction.

B. The Commissioner of The Department of Design and Construction will notify the Asbestos abatement contractor in writing regarding defects in work under the guarantee.

1.11 OCCUPANCY OF SITE NOT EXCLUSIVE

Attention is specifically drawn to the fact that contractors, performing the work of other Contracts, may be brought upon any of the work sites of this Contract. Therefore, the Asbestos abatement contractor shall not have exclusive rights to any site of his work and shall fully cooperate and coordinate his work with the work of other contractors who may

be brought upon any site of the work of this Contract. This paragraph applies to those areas outside the regulated Work Area as defined by Title 15, Chapter I of RCNY.

1.12 SUBMITTALS

A. Pre-Construction Submittals:

1. Attend a pre-construction meeting scheduled by the City of New York Department of Design and Construction. This meeting shall also be attended by a designated representative of the City of New York third party air monitoring firm, facility manager and the Construction Project Manager. At this meeting, the Asbestos abatement contractor shall present three copies of the following items:
   a. Asbestos abatement contractor's scope of work, work plan and schedule.

   b. Asbestos project notifications, approved variances and plans to Government Agencies.

   c. Copies of Permits, clearance and licenses if required.

   d. Schedules: the Asbestos abatement contractor shall provide to the Construction Project Manager a copy of the following schedules for approval. Once approved, schedules shall be maintained and updated as received. Asbestos abatement contractor shall post a copy of all schedules at the site:

      (1) A construction schedule stating critical dates of the project including, but not limited to, mobilization, Work Area preparation, demolition, gross removal, fine cleaning, encapsulation, inspections, clearance monitoring, and phase of refinishing and final inspections. The schedule shall be updated biweekly, at a minimum.

      (2) A schedule of staffing stating number of workers per shift per activity, name and number of supervisor(s) per shift, shifts per day, and total days to be worked.

      (3) Submit all changes in schedule or staffing to the Construction Project Manager prior to implementation.

   e. Written description of emergency procedures to be followed in case of injury or fire. This section must include evacuation procedures, source of medical assistance (name and telephone number to nearest

hospital) and procedures to be used for access by medical personnel (examples: first aid squad and physician). NOTE: Necessary Emergency Procedures Shall Take Priority Over All Other Requirements of These Specifications.

f. Material Safety Data Sheets (MSDS) for encapsulants, sealants, firestopping foam, cleaners/disinfectants, spray adhesive and any and all potentially hazardous materials that may be employed on the project. No work involving the aforementioned will be allowed to proceed until MSDS are reviewed.

g. Worker Training and Medical Surveillance: The Asbestos abatement contractor shall submit a list of the persons who will be employed by him /her to perform the removal work. Present evidence that workers have received proper training required by the regulations and the medical examinations required by OSHA 29 CFR 1926.1101.

h. Logs: Specimen copies of daily progress log, visitor's log, and disposal log.

(1) The Asbestos abatement contractor shall provide a permanently bound log book of minimum 8-1/2" x 11" size at the entrance to the Worker and Waste Decontamination enclosure system as hereinafter specified. Log book shall contain on title page the project name, name, address and phone number of the Asbestos abatement contractor; name, address and phone number of Asbestos abatement contractor and City's third party air monitoring firm; emergency numbers including, but not limited to local Fire/Rescue Department. Log book shall contain a list of personnel approved for entry into the Work Area.

(2) All entries into the log shall be made in non-washable, permanent ink and such pen shall be strung to or otherwise attached to the log to prevent removal from the log-in area. Under no circumstances shall pencil entries be permitted. Any significant events occurring during the abatement project shall be entered into the log. Upon completion of the job, the Asbestos abatement contractor shall submit the logbook containing a day-to-day record of personnel log entries countersigned by the Construction Project Manager every day.

i. Worker's Acknowledgments: Submit statements signed by each employee that the employee has received training in the proper handling of ACM, understands the health implications and risks

involved; and understands the use and limitations of the respiratory equipment to be used.

B. During Construction Submittals:

1. Security and safety logs showing names of person entering workspace, date and time of entry and exit, record of any accident, emergency evacuation, and any other safety and/or health incident.

2. Progress logs showing the number of workers, supervisors, hours of work and tasks completed shall be submitted daily to the Construction Project Manager.

3. Floor plans indicating Asbestos abatement contractor's current work progress shall be submitted for review by the Construction Project Manager.

4. All Asbestos abatement contractors' air monitoring and inspection results.

C. Project Closeout Submittals:

Upon completion of the project and as a condition of acceptance, the Asbestos abatement contractor shall present two copies of the following items, bound and indexed:

1. Lien Waivers from Asbestos abatement contractor, Sub-Asbestos abatement contractors and Suppliers,

2. Daily OSHA air monitoring results,

3. All Waste Manifests (Asbestos and Construction Debris), seals and disposal logs,

4. Field Sign-In/Sign-Out Logs for every shift,

5. Copies of all Building Department Forms and Permits,

6. A Letter of Compliance stating that all the work on this project was performed in accordance with the Specifications and all applicable Federal, State and Local regulations,

7. All Warranties as stated in the Specifications,

   a. Fully executed disposal certificates and transportation manifest.

8. Project Record: The Asbestos abatement contractor shall maintain a project record for all small and large asbestos projects. During the project, the

project record shall be kept on site at all times. Upon completion of the project, the project record shall be maintained by the building owner. The project record shall be submitted to DDC as part of the close out documents. The project record shall consist of:

a. Copies of licenses of all asbestos abatement contractors involved in the project;

b. Copies of NYCDEP and NYSDOL supervisor and handler certificates for all workers engaged in the project;

c. Copies of all project notifications and reports filed with NYCDEP, NYSDOL and USEPA for the project, with any amendments or variances;

d. Copies of all asbestos abatement permits, including associated approved plans and work place safety plan;

e. A copy of the air sampling log and all air sampling results;

f. A copy of the abatement asbestos abatement contractor's daily log book;

g. Copies of all asbestos waste manifests;

h. A copy of all Project Monitor's Reports (ACP-15).

i. A copy of each ATR-1 Form completed for the asbestos project (if required).

j. A copy of each Asbestos Project Conditional Closeout Report (ACP-20) if required.

k. A copy of the Asbestos Project Completion Form (ACP-21).

1.13 PROTECTION OF FURNITURE AND EQUIPMENT

Cover all furniture and equipment that cannot be removed from Work Areas. Movable furniture and equipment will be removed from Work Areas by the Asbestos abatement contractor prior to start of work. At the conclusion of the work (after final air testing), the Asbestos abatement contractor will remove all plastic covering on walls, floors, furniture, equipment and reinstall furniture and equipment. He shall remove and store all sheaths, curtains and drapes, and reinstall same following final clean up.

1.14 UTILITIES

A. General:

All temporary facilities shall be subject to the approval of the Commissioner. Prior to starting work at any site, locations and/or sketches (if required) of temporary facilities must be submitted to the Construction Project Manager for the required approval.

B. Water:

The Department of Design and Construction will furnish all water needed for construction, at no cost to the Asbestos abatement contractor in buildings under their jurisdiction. However, it is the responsibility of the Asbestos abatement contractor to ensure that hot water is provided for showering in the decontamination unit. The Asbestos abatement contractor shall furnish, install and maintain any needed equipment to meet these requirements at his own expense.

C. Electricity:

The Department of Design and Construction will furnish all electricity needed for construction, at no cost to the Asbestos abatement contractor in a building, under their jurisdiction. The Asbestos abatement contractor is responsible for routing the electric power to the abatement Work Area.

All temporary lighting and temporary electrical service for Work Area shall be in weatherproof enclosures and be ground fault protected.

D. In leased spaces, arrangements for water supplies and electricity must be made with the landlord. However, all such arrangements must be made through and are subject to approval of the Department of Design and Construction. Utilities will be provided at no cost to the Asbestos abatement contractor. However, it is the Asbestos abatement contractor's (or the General contractor's) responsibility to furnish and install a suitable distribution system to the Work Area. This system will be provided at no cost to the City.

1.15 FEES

The Asbestos abatement contractor shall be responsible for any and all fees or charges imposed by Local, State or Federal Law, Rule and Regulation applicable to the work specified herein, including fees or charges which may be imposed subsequent to the date of the Bid opening.

END OF SECTION

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SECTION 028213

ASBESTOS ABATEMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. The Contract Documents are as defined in the "Agreement". The General Conditions shall apply to all Work of this Section.

B. Work specified herein shall be the removal and disposal of Asbestos-Containing Materials (ACM) and asbestos-contaminated materials from designated areas of the Brooklyn Public Library, located at 2 Eastern Parkway, Brooklyn, NY 11238.

C. The following documents were reviewed and utilized to generate this abatement design specification which serves to locate and quantify the amount of ACM, and asbestos contaminated material, to be abated in support of this project.

1. Set of 100% Construction Documents drawings labeled "Brooklyn Public Library PlaNYC Energy Audit Retrofit Project," dated 09/17/14, prepared Joseph R. Loring & Associates, Inc.;
2. Asbestos Survey Reports performed by Louis Berger & Assoc., P.C. (LBA) dated 02/26/14 and Limited Asbestos Report dated 10/30/14.

D. The phasing and scheduling of work for this project shall be coordinated with and approved by the Construction Project Manager and Facility Manager. The Construction Project Manager and Facility Manager will make the final determination on all issues under this Contract covered by this Specification.

1.02 SCOPE OF WORK

A. The asbestos abatement contractor is to provide all labor, materials, equipment, services, testing, appurtenances, permits and agreements necessary to perform the work required for the abatement of ACM as required by these contract documents. All work shall be performed in accordance with this Specification, EPA regulations, OSHA regulations, New York City Local Law 70, Title 15, Chapter 1 RCNY, New York State Industrial Code 56, NIOSH recommendations, and any other applicable federal, state or local government regulations. Whenever there is a conflict or overlap of the above references, the most stringent provisions are applicable.

B. The intent of this Specification section is to ensure that the asbestos abatement contractor is responsible for the following:

1. Abatement of all ACM.

2. Cleaning and decontamination of the entire affected area.

3. Demolition that may be required to access ACM in each area, Asbestos abatement contractor shall dispose of all debris associated with demolition activities as ACM waste.

4. Removal and disposal of all ACM found within these areas such as pipe fittings to fiberglass insulation.

5. Provide all scaffolding, platform installation, equipment, tools, transportation and any other equipment required and/or necessary to complete all work described in the Contract Documents.

6. The Asbestos abatement contractor shall be responsible for and shall include any and all fees or changes imposed by Local, State or Federal Law, Rule or Regulation applicable to the work specified herein, including fees or charges which may be imposed subsequent to the work.

7. Prior to destructive demolition activities, the DDC may elect to collect bulk samples of assumed asbestos-containing materials and analyze the bulk samples for asbestos content.

C. The Asbestos abatement contractor shall perform the following work as described below and indicated on the drawings. The drawings are only a diagrammatic representation of the Work Areas and do not constitute the actual quantities of material. Asbestos abatement contractor is responsible for the confirmation of the actual total quantities of the Work.

1. Drawing H002.00: Second Floor Plan

a. Remove and dispose of asbestos-containing pipe fitting to fiberglass insulation, gray within **Work Area 1**. Asbestos-containing pipe fittings to fiberglass insulation, gray shall be removed utilizing NYCDEP Title 15, Chapter 1, § 1-105 Tent and Glove-bag Procedures.

Work Area	Removal Procedure	Approximate Square Feet (Sq. Ft.)	Approximate Linear Feet (Ln. Ft.)
1	NYCDEP Section § 1-105 Tent and Glove-bag Procedures	–	10 Ln. Ft. of Pipe Fittings to Fiberglass Insulation, Gray

D. The facility is under the jurisdiction of the Brooklyn Public Library. The asbestos abatement contractor shall perform the work of this contract in a manner that will be least disruptive to the normal use of the building.

E. Asbestos abatement contractor's attention is directed to the fact that patents cover certain methods of asbestos abatement indicated in the specifications. To date, patents have been issued with regard to negative pressure enclosures or negative or reduced pressure and glove-bag.

F. Asbestos abatement contractor shall be solely responsible for and shall hold the City of New York Department of Design and Construction and the City harmless from, any and all damages, losses and expenses resulting from any infringement by Asbestos abatement contractor of any patent, including but not limited to the patents described above, used by Asbestos abatement contractor during performance of this agreement.

G. Prior to starting, the asbestos abatement contractor must notify the Commissioner of the City of New York Department of Design and Construction if he anticipates any difficulty in performing the work as directed and required by these Specifications. Asbestos abatement contractor shall be required to attend an on-site job meeting with the Construction Project Manager prior to start of work to examine conditions of the site for removal and plan the sequence for removal operations.

H. The asbestos abatement contractor shall retain a certified Project Designer for the preparation of an Asbestos Variance Application (ACP-9), if required.

I. The asbestos abatement contractor shall be responsible for preparing and submitting all filings, notifications, amendments and variances, etc. required by all City, State and Federal regulatory agencies having jurisdiction, at no additional cost to the NYC DDC.

J. The general contractor shall retain a Registered Design Professional (person licensed and registered to practice the professions of architecture or engineering under the Education Law of the State of New York) to prepare a Work Place Safety Plan (WPSP), if required.

K. The general contractor shall retain a Registered Design Professional (person licensed and registered to practice the professions of architecture or engineering under the Education Law of the State of New York) to perform final inspections required pursuant to Title 28 of the Administrative Code, including but not limited to special inspections required under Chapter 17 of the Building Code. Such special inspections and A-TR1 forms shall be completed by the Registered Design professional.

L. For coordination with other Asbestos abatement contractors, see the General Conditions governing all Contracts.

M. Related Asbestos Removal Work Under Other Contracts:

1. Each asbestos abatement contractor shall be responsible for the removal of incidental asbestos not identified in this section and found prior to or during the Work.

2. Incidental asbestos is defined as ACM that is discovered during the course of their work that must be abated to enable them to perform the work of their Contract.

N. Work Hours:

1. The asbestos abatement contractor shall establish his work schedule in a way that avoids interference or conflict with the normal functioning of the facility. Work in the evenings shall be done at no additional cost to the City.

2. All work shall be done during regular working hours unless the Asbestos abatement contractor requests authorization to work other than regular working hours and such authorization is granted by the Commissioner (Regular working hours are those during which any given facility in which work is to be done is customarily open and functioning). If such work schedule is authorized by the Commissioner the work shall be done at no additional cost to the City.

3. The order of phases and start dates associated with each will be determined by the Construction Project Manager.

4. Asbestos abatement contractor shall be required to schedule waste transfer during evening hours, when activity within the facility is at a minimum. Evening hours are defined as 6:00 p.m. to 6:00 a.m. Waste transfer must be approved by the Construction Project Manager and Facility Manager.

O. The following conditions shall apply to all temporary shutdowns of existing services:

1. All temporary lighting and temporary electrical services for use in the Work Area shall be in weather proof enclosures and be ground fault protected and:

2. Shall be performed at no additional charge to the City.

3. Shall be performed at times not interfering with the other activities in the building.

4. Shall be performed only with written consent from the Commissioner and the Facility Manager.

5. Shall be made through written request to the Commissioner at least 10 days in advance with complete written description of the work to be performed.

P. Stages of Asbestos Removal Work:

a. The asbestos abatement contractor will be required to perform the work and it is the intent of this Specification to remove all asbestos containing and asbestos contaminated materials from the Work Area. The asbestos abatement contractor is responsible for verifying all quantities of materials listed.

Q. Certain equipment in the Work Area may need to remain operational during removal. Therefore, the removal of ACM from this equipment shall be performed as the last removal activities within the Work Area. The Asbestos abatement contractor shall coordinate the scheduling for the removal of ACM on functioning equipment with the Construction Project Manager.

1.03 QUALIFICATIONS OF ASBESTOS ABATEMENT CONTRACTOR

A. Requirements: The asbestos abatement contractor must demonstrate compliance with the special experience requirements set forth in subparagraphs (1) through (5) below. The asbestos abatement contractor must submit documentation demonstrating compliance with all listed requirements. Such documentation shall include without limitation, all required licenses, certificates, and documentation.

1. The asbestos abatement contractor must, whether an individual, corporation, partnership, joint venture or other legal entity, demonstrate for the three year period prior to the work, that it has been licensed by the New York State Department of Labor, as an "Asbestos Abatement Contractor".

2. The asbestos abatement contractor must, for the three year period prior to the work, have been in the business of providing asbestos abatement services as a routine part of its daily operations.

3. The asbestos abatement contractor proposing to do asbestos abatement work must be thoroughly experienced in such work and must provide evidence of having successfully performed and completed in a timely fashion at least five (5) asbestos abatement projects of similar size and complexity. The aggregate cost of these projects must be at least $1,000,000 in each of the three years.

4. For each project submitted to meet the experience requirements set forth above, the asbestos abatement contractor must submit the following information for the project; name and location of the project; name title and telephone number of the owner or the owner's representative who is familiar with the asbestos abatement contractor's work; brief description of the work completed as a prime or sub-asbestos abatement contractor; amount of contract or subcontract and the date of completion.

5. The asbestos abatement contractor must demonstrate that it has the financial resources, supervisory personnel and equipment necessary to carry out the work and to comply with the required performance schedule, taking into consideration other business commitments. The asbestos abatement contractor must submit such documentation as may be required by the Department of Design and Construction to demonstrate that it has the requisite capacity to perform the required services of this contract.

B. Throughout the specifications, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics thereof. Provide materials or workmanship that meet or exceed the specifically named codes or standards where required by these specifications.

C. Site Investigation: Asbestos abatement contractor shall inspect all the specifications and related drawings, and will investigate and confirm the site conditions affecting the work, including, but not limited to:

1. Physical considerations and conditions of both the material and structure. These considerations include any obstacles or obstructions encountered in accessing or removing the material.

2. Handling, storage, transportation and disposal of the material.

3. Availability of qualified and skilled labor.

4. Availability of utilities.

5. Exact quantities of all materials to be disturbed and/or removed.

1.04 WORK BY OTHERS

The City reserves the right during the term of this Contract to have work performed on asbestos abatement projects by other asbestos abatement contractors as the situation warrants.

1.05 DEFINITIONS

A. General Explanation: Certain terms used in this Specification Section are defined below. Definitions and explanations of this Specification Section are not necessarily complete or exclusive, but are general for the Work to the extent they are not stated more explicitly in another element of the Contract Documents.

B. Definitions in General Use:

1. Approve: Where used in conjunction with Engineer's response to submittals, requests, applications, inquiries, reports and claims by Asbestos abatement

contractor, the meaning of term "approved" will be held to limitations of Engineer's responsibilities and duties as specified in Contract Documents. In no case will "approval" by Engineer be interpreted as a release of Asbestos abatement contractor from responsibilities to fulfill requirements of Contract Documents.

2. Directed, Requested, etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by Engineer," "requested by Engineer," and similar phrases. However, no such implied meaning will be interpreted to extend Engineer's responsibility into Asbestos abatement contractor's responsibility for construction supervision.

3. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

4. Indicated: The term "indicated" is a cross-reference to graphic representations, notes or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

5. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

6. Installer: The term "installer" is defined as the entity (person or firm) engaged by the asbestos abatement contractor, or its sub-asbestos abatement contractor for performance of a particular unit of work at Project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (installers) be expert in operations they are engaged to perform.

7. Provide: Except as otherwise defined in greater detail, term “provide” means furnish and install, complete and ready for intended use, as applicable in each instance.

8. Third-Party Air Monitor: The term “Third-Party Air Monitor ” is defined as an entity engaged by City and Construction Project Manager to perform specific inspections or tests of the work, either at Project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

C. Definitions Relative to Asbestos Abatement:

1. Abatement: Any and all procedures physically taken to control fiber release from asbestos-containing materials. This includes removal, encapsulation, enclosure, cleanup and repair.

2. Adequately Wet: The complete penetration of a material with amended water to prevent the release of particulates. If visible emissions are observed coming from asbestos-containing material, then the material has not been adequately wetted. However, the absence of visible emissions is not evidence of being adequately wet. ACM must be fully penetrated with the wetting agent in order to be considered adequately wet. If the ACM being abated is resistant to amended water penetration, wetting agent shall be applied to the material prior to and during removal as necessary to minimize fiber release.

3. Aggressive Sampling: Method of sampling in which the individual collecting the air sample creates activity by the use of mechanical equipment during the sampling period to stir up settled dust and simulate activity in that area of the building.

4. AHERA: Asbestos Hazard Emergency Response Act of 1986

5. AIHA: American Industrial Hygiene Association.

6. Airlock: System for permitting entrance and exit while restricting air movement between a contaminated area and an uncontaminated area. It consists of two curtained doorways separated by a distance of at least three feet such that one passes through one doorway into the airlock, allowing the doorway sheeting to overlap and close off the opening before proceeding through the second doorway, thereby preventing flow-through contamination.

7. Air Sampling: Process of measuring the fiber content of a known volume of air collected during a specific period. The procedure utilized for asbestos follows the NIOSH Standard Analytical Method 7400, or the provisional transmission electron microscopy methods developed by the US EPA which is utilized for lower detection levels and specific fiber identification.

8. Ambient Air Monitoring: "Ambient air monitoring" shall mean measurement or determination of airborne asbestos fiber concentrations outside but in the general vicinity of the worksite.

9. Amended Water: Water to which a surfactant has been added.

10. ANSI: American National Standards Institute

11. Area Air Sampling: Any form of air sampling or monitoring where the sampling device is placed at some stationary location.

12. Asbestos: Any hydrated mineral silicate separable into commercially usable fibers, including but not limited to chrysotile (serpentine), amosite (cumingtonite-grunerite), crocidolite (riebeckite), tremolite, anthophyllite and actinolite.

13. Asbestos-Containing Material (ACM): Asbestos or any material containing more than one-percent asbestos.

14. Asbestos-Containing Waste Material: ACM, asbestos-contaminated objects or debris associated with asbestos abatement requiring disposal.

15. Asbestos-Contaminated Objects: Any objects which have been contaminated by asbestos or asbestos-containing material.

16. Asbestos Assessment Report: "Asbestos Assessment Report" shall mean the "Form ACP-5" form, as approved by NYCDEP, by which a NYCDEP-certified asbestos investigator certifies that a building or structure (or portion thereof) is free of ACM or the amount of ACM to be abated constitutes a minor project.

17. Asbestos Handler: Individual who disturbs, removes, repairs, or encloses asbestos material. This individual shall have completed approved training course(s) and be in possession of certification issued by NYCDEP and NYSDOL.

18. Asbestos Handler Supervisor: Individual who supervises the handlers during an asbestos project and ensures that proper asbestos abatement procedures as well as individual safety procedures are being adhered to. This individual shall have completed approved training course(s) and be in possession of certification issued by NYCDEP and NYSDOL.

19. Asbestos Investigator: An individual certified by NYCDEP as having successfully demonstrated his or her ability to identify the presence of and evaluate the condition of asbestos in a building or structure.

20. Asbestos Project: Any form of work performed in a building or structure which will disturb (e.g., remove, enclose, encapsulate) more than 25 linear feet or more than 10 square feet of asbestos-containing material.

21. ASTM: American Society for Testing and Materials.

22. Asbestos Project Notification: The "Form ACP-7" asbestos project notification form as approved by DEP.

23. Authorized Visitor: Authorized visitor shall mean the building owner and his/her representative, and any representative of a regulatory or other agency having jurisdiction over the project.

24. Building Owner: Person in whom legal title to the premises is vested unless the premises are held in land trust, in which instance Building Owner means the person in whom beneficial title is vested.

25. Building Materials: Any and all manmade materials, including but not limited to interior and exterior finishes, equipment, bricks, mortar, concrete, plaster, roofing, flooring, caulking, sealants, tiles, insulation, and outdoor paving such as sidewalks, paving tiles and asphalt.

26. Certified Industrial Hygienist (CIH): Individual with a minimum of five years experience as an industrial hygienist and who has successfully completed both levels of the examination administered by the American Board of Industrial Hygiene and who is currently certified by that board.

27. Certified Safety Professional (CSP): Individual having a bachelor's degree from an accredited college or university and a minimum of four years experience as a safety professional and who has successfully completed both levels of the examination administered by the Board of Certified Safety Professionals and who is currently certified by that board.

28. Chain of Custody: "Chain of Custody" shall mean the form or set of forms that document the collection and transfer of a sample.

29. City: City of New York

30. Clean Room: An uncontaminated area or room that is part of worker decontamination enclosure system with provisions for storage of workers' street clothes and protective equipment.

31. Clearance Air Monitoring: Employment of aggressive sampling techniques with a volume of air collected to determine the airborne concentration of residual fibers and shall be performed as the final abatement activity.

32. Commissioner: shall mean the head of the Agency that has entered into this contract or his/her duly authorized representative.

33. Competent Person: Shall mean the designated person as defined by OSHA in 29 CFR1926.1101.

34. Curtained Doorway: Device that consists of at least three overlapping sheets of fire retardant plastic over an existing or temporarily framed doorway. One sheet shall be secured at the top and left side, the second sheet at the top and right side, and the third sheet at the top and left side. All sheets shall

have weights attached to the bottom to ensure that the sheets hang straight and maintain a seal over the doorway when not in use.

35. Decontamination Enclosure System: Series of connected rooms, separated from the Work Area and from each other by air locks, for the decontamination of workers, materials, waste containers, and equipment.

36. Demolition: The dismantling or razing of a building, including all operations incidental thereto (except for asbestos abatement activities), for which a demolition permit from the New York City Department of Buildings is required.

37. NYCDEP or DEP: The New York City Department of Environmental Protection.

38. Disturb: Any action taken which may alter, change, or stir, such as but not limited to the removal, encapsulation, enclosure or repair of asbestos-containing material.

39. DOB: The New York City Department of Buildings.

40. Egress: A continuous and unobstructed path of vertical and horizontal egress travel from any occupied portion of a building or structure to a public way. A means of egress consists of three separate and distinct parts: the exit access, the exit and the exit discharge.

41. ELAP: Environmental Laboratory Approval Program administered by the New York State Department of Health.

42. Encapsulant (sealant) or Encapsulating Agent: Liquid material which can be applied to ACM and which temporarily controls the possible release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant). A thin coat of lockdown encapsulant shall be applied to all surfaces in the work area which were not the subject of removal or abatement, including the cleaned layer of the surface barriers, but excepting sprinklers, standpipes, and other active elements of the fire suppression system.

43. Encapsulation: The coating or spraying of asbestos-containing material encapsulant. A thin coat of lockdown encapsulant shall be applied to all surfaces in the work area which were not the subject of removal or abatement, including the cleaned layer of the surface barriers, but excepting sprinklers, standpipes, and other active elements of the fire suppression system.

44. Enclosure: Construction of airtight walls and/or ceilings between ACM and the facility environment, or around surfaces coated with ACM, or any other appropriate procedure as determined by the NYCDEP which prevents the release of asbestos fibers.

45. EPA or USEPA: United States Environmental Protection Agency.

46. Equipment Room: Contaminated area or room that is part of the worker decontamination enclosure system with provisions for the storage of contaminated clothing and equipment.

47. Exit: That portion of a means of egress system which is separated from other interior spaces of a building or structure by fire-resistance-rated construction to provide a protected path of egress travel between the exit access and the exit discharge.

48. FDNY: The Fire Department of the City of New York.

49. Fiber: An acicular single crystal or a similarity elongated polycrystalline aggregate which displays some resemblance to organic fibers by having such properties as flexibility, high aspect ratio, silky luster, axial lineation, and others, and which has attained its shape primarily through growth rather than cleavage.

50. Fixed Object: A unit of equipment, furniture, or other item in the work area which cannot be removed from the work area. Fixed objects shall include equipment, furniture, or other items that are attached, in whole or in part, to a floor, ceiling, wall, or other building structure or system or to another fixed object and cannot be reasonably removed from the work area. Fixed objects shall also include pipes and other equipment inside the work area which are not the subject of the asbestos project. Active fire suppression system components shall not be considered fixed objects.

51. Glovebag technique: shall mean a method for removing asbestos-containing material from heating, ventilation and air conditioning (HVAC) ducts, short piping runs, valves, joints, elbows, and other nonplanar surfaces. The glovebag assembly is a manufactured device consisting of a large bag (constructed of at least 6-mil transparent plastic), two inward-projecting long sleeve gloves, one inward-projecting waterwand sleeve, an internal tool pouch, and an attached, labeled receptacle for asbestos waste. The glovebag is constructed and installed in such a manner that it surrounds the object or area to be decontaminated and contains all asbestos fibers released during the removal process.

52. HEPA-Filter: High efficiency particulate air filter capable of trapping and retaining 99.97 percent of particles (asbestos fibers) greater than 0.3 micrometers mass median aerodynamic equivalent diameter.

53. HEPA vacuum equipment: "HEPA vacuum equipment" shall mean vacuuming equipment with a HEPA filter.

54. Holding Area: Chamber in the equipment decontamination enclosure located between the washroom and an uncontaminated area.

55. Homogeneous Work Area: Portion of the Work Area that contains one type of ACM and/or where one type of abatement is used.

56. Industrial Hygiene: Science and art devoted to the recognition, evaluation, and control of those environmental factors or stresses, arising in or from the work place, which may cause sickness, impaired health and well being, or significant discomfort and inefficiency among worker or among the citizens of the community.

57. Industrial Hygienist: Individual having a college or university degree or degrees in Engineering, Chemistry, Physics or Medicine, or related Biological Sciences who, by virtue of special studies and training, has acquired competence in industrial hygiene. Such special studies and training must have been sufficient in all of the above cognate sciences to provide the abilities:

    a. To recognize the environmental factors and to understand their effect on people and their well being; and

    b. To evaluate, on the basis of experience and with the aid of quantitative measurement techniques, the magnitude of these stresses in terms of ability to impair people's health and well being; and

    c. To prescribe methods to eliminate, control, or reduce such stresses when necessary to alleviate their efforts.

58. Isolation Barrier: The construction of partitions, the placement of solid materials, and the plasticizing of apertures to seal off the work place from surrounding areas and to contain asbestos fibers in the work area.

59. Large Asbestos Project: Asbestos project involving the disturbances (e.g., removal, enclosure, encapsulation) of 260 linear feet or more of ACM or 160 square feet or more of ACM.

60. Log: An official record of all activities that occurred during the project. At a minimum, the log shall identify the building owner, agent, asbestos abatement contractor, and workers, and other pertinent information including daily activities, cleanings and waste transfers, names and certificate numbers of asbestos handler supervisors and asbestos handlers; results of inspections of decontamination systems, barriers, and negative pressure ventilation equipment; summary of corrective actions and repairs; work stoppages with reason for stoppage; manometer readings at least twice per work shift; daily checks of emergency and fire exits and any unusual events.

61. Minor Project: A project involving the disturbance (e.g., removal, enclosure, encapsulation, repair) of 25 linear feet or less of asbestos containing material or 10 square feet or less of asbestos containing material.

62. Movable Object: Unit of equipment or furniture in the Work Area that can be removed from the Work Area.

63. Negative Air Pressure Equipment: Portable local exhaust system equipped with HEPA filtration. The system shall be capable of creating a negative pressure differential between the outside and inside of the Work Area.

64. NESHAPS: National Emission Standards for Hazardous Air Pollutants.

65. NFPA: The National Fire Protection Association.

66. NIOSH: National Institute for Occupational Safety and Health.

67. DEP or NYCDEP: New York City Department of Environmental Protection

68. NYSDOL: New York State Department of Labor.

69. NYSDOL ICR 56: "NYSDOL ICR 56" shall mean Part 56 of the Official Compilation of Codes, Rules and Regulations of the State of New York or 12 NYCRR Part 56.

70. NYSDOH: The New York State Department of Health.

71. Obstruction: The blocking of a means of egress with any temporary structure or barrier. A double layer of fire-retardant 6-mil polyethylene sheeting shall not be considered an obstruction when it is prominently marked as an exit with photo luminescent signage or paint and cutting tools (knife, razor) are attached to the work area side of the sheeting for use in the event that the sheeting must be cut to permit egress. A corridor shall not be considered obstructed when there is a clear path measuring at least three (3) feet wide.

72. Occupied Area: Area of the work site where abatement is not taking place and where personnel or occupants normally function or where workers are not required to use personal protective equipment.

73. OSHA: Occupational Safety and Health Administration.

74. Outside air: "Outside air" shall mean the air outside the work place.

75. Person: Individual, partnership, company, corporation, association, firm, organization, governmental agency, administration, or department, or any other group of individuals, or any officer or employee thereof.

76. Personal Air Monitoring: Method used to determine employees' exposure to airborne asbestos fibers. The sample is collected outside the respirator in the worker's breathing zone.

77. Personal Protective Equipment (PPE): Appropriate protective clothing, gloves, eye protection, footwear, and head gear.

78. Phase Contrast Microscopy (PCM): The measurement protocol for the assessment of the fiber content of air. (NIOSH Method 7400).

79. Physician: Person licensed or otherwise authorized under Article 131 Section 65.22 of the New York State Education Law.

80. Plasticize: To cover floors and walls with fire retardant plastic sheeting as herein specified or by using spray plastics as acceptable to the Department.

81. Polarized Light Microscopy (PLM): The measurement protocol for the assessment of the asbestos content of bulk materials. (Interim Method for the Determination of Asbestiform Materials in Bulk Insulation Samples- 40 CFR Part 763, Subpart F, Appendix A as amended on September 1, 1982)

82. Project Designer: A person who holds a valid Project Designer Certificate issued by the New York State Department of Labor.

83. Project Monitor: A person who holds a valid Project Monitor Certificate issued by the New York State Department of Labor.

84. Qualitative Fit Test: Individual test subject's responding (either voluntarily or involuntarily) to a chemical challenge outside the respirator face-piece. Acceptable methods include irritant smoke test, odorous vapor test, and taste test.

85. Quantitative Fit Test: Exposing the respiratory wearer to a test atmosphere containing an easily detectable, nontoxic aerosol, vapor or gas as the test agent. Instrumentation, which samples the test atmosphere and the air inside the face-piece of the respirator, is used to measure quantitatively the leakage into the respirator. There are a number of test atmospheres, test agents, and exercises to perform during the test.

86. Registered Design Professional: A person licensed and registered to practice the professions of architecture or engineering under the Education Law of the State of New York.

87. Removal: Stripping of any asbestos- containing materials from surfaces or components of a facility or taking out structural components in accordance with 40 CFR 61 Subparts A and M.

88. Renovation: An addition or alteration or change or modification of a building or the service equipment thereof, that is not classified as an ordinary repair as defined in §27-125 of the Administrative Code of the City of New York.

89. Repair: Corrective action using specified work practices (e.g., glovebag, plastic tent procedures, etc.) to minimize the likelihood of fiber release from minimally damaged areas of ACM.

90. Replacement material: Any material used to replace ACM that contains less than .01 percent asbestos.

91. Shift: A worker's, or simultaneous group of workers', complete daily term of work.

92. Shower Room: Room between the clean room and the equipment room in the worker decontamination enclosure with hot and cold running water controllable at the tap and arranged for complete showering during decontamination.

93. Small Asbestos Project: Asbestos project involving the disturbance (e.g., removal, enclosure, encapsulation) of more than 25 and less than 260 linear feet of ACM or more than ten and less than 160 square feet of ACM.

94. Staging Area: Work Area near the waste transfer airlock where containerized asbestos waste has been placed prior to removal from the Work Area.

95. Strip: To remove asbestos materials from any part of the facility.

96. Structural Member: Load-supporting member of a facility, such as beams and load-supporting walls, or any non-load-supporting member, such as ceiling and non-load-supporting walls.

97. Surface barriers: The plasticizing of walls, floors, and fixed objects within the work area to prevent contamination from subsequent work.

98. Surfactant: Chemical wetting agent added to water to improve penetration.

99. Transmission Electron Microscopy (TEM): The measurement protocol for the assessment of the asbestos fiber content of air. Interim Transmission Electron Microscopy Analytical Methods-40 CFR Part 763, Subpart E, Appendix A.

100. Visible Emissions: Emissions containing particulate material that are visually detectable without the aid of instruments.

101. Washroom: Room between the Work Area and the holding area in the equipment decontamination enclosure system where equipment and waste containers are wet cleaned and/or HEPA-vacuumed prior to disposal.

102. Waste decontamination enclosure system: "Waste decontamination enclosure system" shall mean the decontamination enclosure system designated for the controlled transfer of materials and equipment, consisting of a washroom and a holding area.

103. Wet Cleaning: "Wet cleaning" shall mean the removal of asbestos fibers from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water.

104. Wet methods: "Wet methods" shall mean the use of amended water or removal encapsulants to minimize the generation of fibers during ACM disturbance.

105. Work Area: Designated rooms, spaces, or areas of the building or structure where asbestos abatement activities take(s) place.

106. Worker Decontamination Enclosure System: Portion of a decontamination enclosure system designed for controlled passage of workers and authorized visitors, consisting of a clean room, a shower room, and an equipment room separated from each other and from the Work Area by airlocks and curtained doorways.

107. Work Place: The work area and the decontamination enclosure system(s).

108. Work Place Safety Plan: Construction documents prepared by a registered design professional and submitted for review by DEP in order to obtain an asbestos abatement permit. Such plan shall include, but not be limited to, plans, sections, and details of the work area clearly showing the extent, sequence, and means and methods by which the work is to be performed.

109. Work Site: Premises where abatement activity is being performed. May be composed of one or more Work Areas.

1.06 STANDARD OPERATING PROCEDURES

A. Develop and implement a written standard procedure for abatement work to ensure maximum protection and safeguard from asbestos exposure of the workers, visitors, employees, public, and environment.

B. TELEPHONE PAGING DEVICE

The asbestos abatement contractor or his authorized representative shall, at all times during the normal workday or during periods of overtime work under this Contract, carry a digital telephone paging device ("Beeper") and/or cellular telephones which can be activated by a telephone number in the 212 or 646 or 718 or 917 or 929 area code. He shall supply the Department of Design and Construction with the activation number for the device and he is liable to respond back to the calls from DDC within the next one (1) hour period after he receives calls from DDC. The cost to the asbestos abatement contractor for this device and all charges accruing thereto is deemed included in the work.

C. The standard operating procedure shall ensure:

1. Tight security from unauthorized entry into the workspace.

2. Restriction of asbestos abatement contractor's personnel to the immediate Work Area and access/egress routes.

3. Donning of proper protective clothing and respiratory protection prior to entering the Work Area.

4. Safe work practices in the work place, including provisions for inter-room communications, exclusion of eating, drinking, smoking, or in any way breaking the respiratory protection.

5. Proper exit practices from the work space to the outside through the showering and decontamination facilities.

6. Removing asbestos in a way that minimizes release of fibers.

7. Packing, labeling, loading, transporting, and disposing of contaminated material in a way that minimizes exposure and contamination.

8. Emergency evacuation procedures, for medical or safety situations, to minimize the potential exposure to airborne asbestos fibers for emergency personnel, building occupants, and building environment.

9. Safety from accidents in the workspace, especially from electrical shocks, fall hazards associated with scaffolding, slippery surfaces, and entanglements in loose hoses and equipment.

10. Provisions for effective supervision, air monitoring and personnel monitoring for exposure during the work.

11. Engineering controls that minimize exposure to fibers within the workspace.

12. The asbestos abatement contractor shall provide a 24-hour fire watch throughout the entire term of the project, to protect against fire and unauthorized entry into the workspace. Fire watch shall be performed by an individual who is a certified asbestos worker capable of entering the Work Area for regular inspections.

D. Provide an Asbestos Handler Supervisor to provide continuous supervision of all work, and to be responsible for the following:

1. Ensure that individuals are using proper personal protective equipment, are trained in its use and hold valid NYCDEP and NYSDOL Asbestos Handler certificates

2. Maintain entry log records and ensure that they are recorded in accordance with the provisions of Title 15, Chapter 1 of RCNY and NYSDOL ICR 56.

3. Surveillance of the Work Areas at a minimum of once per work shift or as required by Title 15, Chapter 1 of RCNY and NYSDOL ICR 56 -7.3, to ensure the integrity of work place isolation, negative pressure equipment and workers personal protective equipment is not torn or ripped and that respiratory protection is worn at all times.

4. Ensure that sufficient personal protective equipment is stored in the clean room.

5. Take precautions to prevent heat stress. Precautions include, but are not limited to, selecting lightweight protective clothing, reducing the work rate, and providing adequate fluid breaks.

6. Perform work area inspection with project monitor prior to the commencement of final clearance air monitoring.

7. The asbestos abatement contractor shall retain the asbestos handler supervisor to perform a visual inspection prior to the post-abatement clearance air monitoring to confirm that all containerized waste has been removed from work and holding areas and there is no visible ACM debris or residue on or about all abated surfaces.

E. ENGINEERING CONTROLS

1. The 8-hour time weighted average airborne concentration of fibers to which any passerby may be exposed shall not exceed 0.01 fibers per cubic centimeter of air when fibers have a physical dimension longer than 5 micrometers as determined by the method prescribed in these Specifications.

2. All asbestos projects shall utilize negative pressure ventilation equipment.

   a. The asbestos abatement contractor shall use a manometer to document the pressure differential. The asbestos abatement contractor shall install and make the manometer operational once the negative pressure has been established in the work area. Magnahelic manometers shall be calibrated at least every six months and a copy of the current calibration certification shall be available at the work site.

3. Negative pressure ventilation equipment shall be installed and operated to provide at least one air change in the work area every 15 minutes. Where there are no floor or wall barriers because floor or wall material is being abated, there shall be at least one air change in the work area every ten minutes.

4. The negative pressure ventilation equipment shall operate continuously, 24 hours a day, from the establishment of isolation barriers through successful clearance air monitoring. If such equipment shuts off, adjacent areas shall be monitored for asbestos fibers.

5. A static negative air pressure of 0.02 inches (minimum) water column shall be maintained at all times in the work place during abatement to ensure that contaminated air in the Work Area does not filter back to uncontaminated areas.

6. If the contaminated area of an asbestos project covers the entire floor of the affected building, or an area greater than 15,000 square feet on any given floor, the installation of a negative air cut off switch or switches shall be required at a single location outside the work place, such as inside a stairwell, or at a secured location in the ground floor lobby when conditions warrant. The required switch or switches shall be installed by a licensed electrician pursuant to a permit issued by the Department of Buildings. If

negative pressure ventilation equipment is used on multiple floors, the cut off switch shall be able to turn off the equipment on all floors.

7. On loss of negative pressure or electric power to the negative pressure ventilating units, abatement shall stop immediately and shall not resume until power is restored and negative pressure ventilation equipment is operating again.

8. Negative pressure ventilation equipment shall be exhausted to the outside of the building away from occupied areas.

   a. All openings (including but not limited to operable windows, doors, vents, air intakes or exhausts of any mechanical devices) less than 15 feet from the exterior exhaust duct termination location shall be plasticized with two layers of fire retardant 6-mil polyethylene sheeting, or a second negative pressure ventilation unit with the primary unit's capacity shall be connected in series prior to exhausting to the outside.

   b. Negative pressure ventilation equipment shall exhaust away from areas accessible to the public.

   c. All ducting shall be sealed and braced or supported to maintain airtight joints. Ducts shall be reinforced and shall be installed so as to prevent breakage. Damage to ducts must be repaired immediately.

9. Where ducting to the outside is not possible, a second negative pressure ventilation unit compatible with the primary unit's capacity shall be connected in series. The area receiving the exhaust shall have sufficient, non-recycling exhaust capacity to the outside of the structure.

10. In the event that there is a failure of the containment system or a breach in the Isolation Barriers, all abatement work will cease and the asbestos abatement contractor will immediately correct the condition. Abatement work will not resume until the Work Area has been smoke tested by the third party laboratory and approved by the Construction Project Manager.

F. LOCKDOWN ENCAPSULATION PROCEDURES

1. The following procedures shall be followed to seal in non-visible residue while conducting lockdown encapsulation on all surfaces from which ACM has not been removed:

   a. Only encapsulants rated as acceptable or marginally acceptable on the basis of Battelle Columbus Laboratory test procedures and rating requirements developed under the 1978 USEPA Contract shall be used for lockdown encapsulation.

b. The encapsulant solvent or vehicle shall not contain a volatile hydrocarbon unless reviewed and approved by DEP.

c. Latex paint with solids content greater than 15 percent shall be considered a lockdown sealant for coating all non-metallic surfaces.

d. Encapsulants shall be applied using airless spray equipment. Spraying is to occur at the lowest pressure range possible to minimize fiber release from encapsulant impact at the surface. It shall be applied with a consistent horizontal or vertical motion.

e. The cleaned layer of the surface barriers shall be removed from walls and floors.

The isolation barriers shall remain in place throughout cleanup. Decontamination enclosure systems shall remain in place and be utilized. A thin coat of lockdown encapsulant shall be applied to all surfaces in the work area which were not the subject of removal or abatement, including the cleaned layer of the surface barriers, but excepting sprinklers, standpipes, and other active elements of the fire suppression system.

1.07 NOTIFICATIONS, PERMITS, WARNING SIGNS, LABELS, AND POSTERS

A. The asbestos abatement contractor shall submit an Asbestos Project Notification (ACP-7) to the NYCDEP listing each work area within the building separately one week in advance of the start of work.

B. The registered design professional shall obtain an asbestos abatement permit authorizing the performance of construction work as required for asbestos projects involving one or more of the following activities:

1. Obstruction of an exit door leading to an exit stair or the exterior of the building;

2. Obstruction of an exterior fire escape or access to that fire escape;

3. Obstruction of a fire-rated corridor leading to an exit door;

4. Removal of handrails in an exit stair or ramp;

5. Removal or dismantling of any fire alarm system component including any fire alarm-initiating device (e.g., smoke detectors, manual pull station);

6. Removal or dismantling of any exit sign or any component of the exit lighting system, including photo luminescent exit path markings;

7. Removal or dismantling of any part of a sprinkler system including piping or sprinkler heads;

8. Removal or dismantling of any part of a standpipe system including fire pumps or valves;

9. Removal of any non-load bearing / non-fire-rated wall (greater than 45 square feet or 50 percent of a given wall);

10. Any plumbing work other than the repair or replacement of plumbing fixtures;

11. Removal of any fire-resistance rated portions of a wall, ceiling, floor, door, corridor, partition, or structural element enclosure including spray-on fire resistance rated materials;

12. Removal of any fire damper, smoke damper, fire stopping material, fire blocking, or draft stopping within fire-resistance rated assemblies or within concealed spaces;

13. Any work that otherwise requires a permit from the DOB (full demolitions, alterations, renovations, modifications or plumbing work).

C. The asbestos abatement contractor shall provide a floor plan showing the areas of the building under abatement and the location of all fire exits in said areas. It shall be prominently posted in the building lobby or comparable location, along with a notice stating the location within the building of the negative air cutoff switch, if applicable.

D. The general contractor shall submit, as required, an asbestos abatement permit due to one or more of the activities listed in 1.07 (B) (1-8) and (B) (13) of this specification. The asbestos abatement contractor is responsible for submitting, with an asbestos project notification, a work place safety plan (WPSP) and any other applicable construction documents. These documents must be prepared by a registered design professional.

E. A WPSP is not required for projects requiring an asbestos abatement permit due to one or more of the activities listed in 1.07 (B) (9-12) of this specification. The asbestos abatement contractor shall submit, together with the asbestos project notification, all applicable asbestos abatement permit construction documents.

F. The general contractor shall retain a Registered Design Professional to perform the inspections required pursuant to Title 28 of the Administrative Code, including but not limited to special inspections required by Chapter 17 of the Building Code, as follows:

1. A final inspection shall be performed by a registered design professional retained by the asbestos abatement contractor after all work authorized by the asbestos abatement permit is completed. The person performing the inspection shall note all failures to comply with the provisions of the Building Code or approved asbestos abatement permit and shall promptly notify the owner in writing. All defects noted in such inspection shall be corrected. The final inspection report shall either:

   a. Confirm:

      (1) That the construction work is complete, including the reinstallation or reactivation of any building fire safety or life safety component.

      (2) That any defects previously noted have been corrected.

      (3) That all required inspections were performed.

      (4) That the work is in substantial compliance with the approved asbestos abatement permit construction documents, the Building Code, and other applicable laws and rules.

   b. Confirm:

      (1) That the construction work does not return the building (or portion thereof) affected by the abatement project to a condition compliant with the building code and other applicable laws and rules, but that the registered design professional has reviewed an application for asbestos abatement permit construction documents approval that has been approved by the department of buildings, and the subsequent scope of work as approved will, upon completion, render all areas affected by the asbestos project in full compliance with the building code and all applicable laws and rules.

      (2) That any defects previously noted that are not addressed by the subsequent scope of work as approved by the department of buildings, have been corrected.

      (3) That all required inspections that are not addressed by the subsequent scope of work as approved by the department of buildings were performed.

      (4) That all completed work pursuant to an asbestos abatement permit is in substantial compliance with the approved asbestos abatement permit construction documents.

G. The general contractor shall provide the final inspection reports to be filed with DEP on A-TR1 form. Records of final inspections made by registered design professionals shall be submitted to DDC as part of the close out document package.

H. Erect bilingual (English-Spanish) warning signs around the work space and at every point of potential entry from the outside and at main entrance to building which can be viewed by the public without obstruction, in accordance with OSHA 29 CFR 1926.1101 (K) (Sign Specifications) and Title 15, Chapter 1 of RCNY. The warning signs shall be a bright color so that they will be easily noticeable. The size of the sign and the size of the lettering shall be no less than OSHA requirements.

I. Provide the required labels for all polyethylene bags and all drums utilized to transport contaminated material to the landfill in accordance with OSHA 29 CFR 1926.1101 (K)(2) and by 49 CFR Parts 171 and 172 of the Department of Transportation regulations.

J. Provide any other signs, labels, warnings, and posted instructions that are necessary to protect, inform and warn people of the hazard from asbestos exposure. Post in a prominent and convenient place for the workers a copy of the latest applicable regulations from OSHA, EPA, NIOSH, State of New York and New York City and any additional items mandated for posting by the aforementioned regulations.

K. Furnish all permits, variances and notices required to perform the Work.

1.08 EMERGENCY PRECAUTIONS

A. Establish emergency and fire exits from the Work Area. The clean side of all emergency exits shall be equipped with two full sets of protective clothing and respirators at all times.

B. Notify local medical emergency personnel, both ambulance crews and hospital emergency room staff prior to commencement of abatement operations as to the possibility of having to handle contaminated or injured workmen, and shall be advised on safe decontamination.

C. Prepare to administer first aid to injured personnel after decontamination. Seriously injured personnel shall be treated immediately or evacuated immediately for decontamination. When an injury occurs, precautions shall be taken to reduce airborne fiber concentrations (i.e., misting of the air with water) until the injured person has been removed from the Work Area.

D. Notify, before actual removal of the asbestos material, the local police and fire departments to the danger of entering the Work Area. Asbestos abatement contractor shall make every effort to help these agencies form plans of action should their personnel need to enter the contaminated area.

1.09 SUBMITTALS

A. Pre-Construction Submittals:

1. Attend a pre-construction meeting scheduled by the City of New York Department of Design and Construction. This meeting shall also be attended by a designated representative of the City of New York third party air monitoring firm, facility manager and the Construction Project Manager. At this meeting, the asbestos abatement contractor shall present three copies of the following items, bound and indexed. The detailed plan of action must be submitted at least five (5) days prior to the pre-construction meeting.

   a. Asbestos abatement contractor's scope of work, work plan and schedule.

   b. Asbestos project notifications, approved variances and plans to Government Agencies.

   c. Copies of Permits, clearance and licenses if required.

   d. Schedules: the asbestos abatement contractor shall provide to the Construction Project Manager a copy of the following schedules for approval. Once approved, schedules shall be maintained and updated as received. Asbestos abatement contractor shall post a copy of all schedules at the site:

      (1) A construction schedule stating critical dates of the project including, but not limited to, mobilization, Work Area preparation, demolition, gross removal, fine cleaning, encapsulation, inspections, clearance monitoring, and phase of refinishing and final inspections. The schedule shall be updated biweekly, at a minimum.

      (2) A schedule of staffing stating number of workers per shift per activity, name and number of supervisor(s) per shift, shifts per day, and total days to be worked.

      (3) Submit all changes in schedule or staffing to the Construction Project Manager prior to implementation.

(4) A schedule of equipment to be used including numbers and types of all major equipment such as HEPA Air Filtration Units, HEPA-vacuums, airless sprayers, Water Atomizing Devices and Type "C" compressors.

e. A written plan and shop drawings for preparation of work site and decontamination chamber.

f. Description of protective clothing and approved respirator to be used, make, model, NIOSH approval numbers.

g. Delineation of responsibility of work site supervision, including competent person, with names, resumes, and home telephone numbers.

h. Explanation of decontamination sequence and isolation techniques.

i. Description of specific equipment to be utilized, including make and model number of air filtration devices, vacuums, sprayers, etc.

j. Description of any prepared methods, procedures, techniques, or equipment other than those specified in the Contract Documents.

k. Explanation of the handling of asbestos contaminated wastes including EPA and NYCDEP identification numbers of Waste Hauler.

l. Description of the final clean-up procedures to be used.

m. Name and qualifications of asbestos abatement asbestos abatement contractor's Air Monitor including AIHA accreditation, and proof of NIOSH PAT and NIST/NVLAP Bulk Quality Assurance Proficiency of OSHA samples for approval by the City of New York Department of Design and Construction.

n. Written description of emergency procedures to be followed in case of injury or fire. This section must include evacuation procedures, source of medical assistance (name and telephone number) and procedures to be used for access by medical personnel (examples: first aid squad and physician). NOTE: Necessary Emergency Procedures Shall Take Priority Over All Other Requirements of These Specifications.

o. Material Safety Data Sheets (MSDS) for encapsulants, sealants, firestopping foam, cleaners/disinfectants, spray adhesive and any and all potentially hazardous materials that may be employed on the project. No work involving the aforementioned will be allowed to proceed until MSDS are reviewed.

p. Worker Training and Medical Surveillance: Asbestos abatement contractor shall submit a list of the persons who will be employed by him in the removal work. Present evidence that workers have received proper training required by the regulations and the medical examinations required by OSHA 29 CFR 1926.1101.

q. Logs: Specimen copies of daily progress log, visitor's log, and disposal log.

(1) The asbestos abatement contractor shall provide a permanently bound log book of minimum 8-1/2" x 11" size at the entrance to the Worker and Waste Decontamination enclosure system as hereinafter specified. Log book shall contain on title page the project name, name, address and phone number of Environmental Control Representative; name, address and phone number of asbestos abatement contractor; name, address and phone number of asbestos abatement contractor and City's air testing entity; emergency numbers including, but not limited to local Fire/Rescue Department. Log book shall contain a list of personnel approved by the laboratory for entry into the Work Area.

(2) All entries into the log shall be made in non-washable, permanent ink and such pen shall be strung to or otherwise attached to the log to prevent removal from the log-in area. Under no circumstances shall pencil entries be permitted. Any significant events occurring during the abatement project shall be entered into the log. Upon completion of the job, the Asbestos abatement contractor shall submit a copy of the logbook containing a day-to-day record of personnel log entries countersigned by the Construction Project Manager every day.

r. Worker's Acknowledgments: Submit statements signed by each employee that the employee has received training in the proper handling of ACM, understands the health implications and risks involved; and understands the use and limitations of the respiratory equipment to be used.

B. Submit copies of the following items to the Construction Project Manager during the work:

1. Security and safety logs showing names of person entering workspace, date and time of entry and exit, record of any accident, emergency evacuation, and any other safety and/or health incident.

2. Progress logs showing the number of workers, supervisors, hours of work and tasks completed shall be submitted daily to the Construction Project Manager.

3. Floor plans indicating asbestos abatement asbestos abatement contractor's current work progress shall be submitted for review by the Construction Project Manager at weekly progress meetings.

4. All asbestos abatement contractors' air monitoring and inspection results.

C. Project Closeout Submittals:

Upon completion of the project and as a condition of acceptance, the asbestos abatement contractor shall present two copies of the following items, bound and indexed:

1. Lien Waivers from asbestos abatement contractor, Sub-asbestos abatement contractors and Suppliers,

2. Daily OSHA air monitoring results,

3. All Waste Manifests (Asbestos and Construction Debris), seals and disposal logs,

4. Field Sign-In/Sign-Out Logs for every shift,

5. Copies of all Building Department Forms and Permits,

6. A Letter of Compliance stating that all the work on this project was performed in accordance with the Specifications and all applicable Federal, State and Local regulations,

7. All Warranties as stated in the Specifications,

   a. Fully executed disposal certificates and transportation manifest.

8. Project Record: The asbestos abatement contractor shall maintain a project record for all small and large asbestos projects. During the project, the project record shall be kept on site at all times. Upon completion of the project, the project record shall be maintained by the building owner. The project record shall be submitted to DDC as part of the close out documents. The project record shall consist of:

a. Copies of licenses of all asbestos abatement contractors involved in the project;

b. Copies of DEP and NYSDOL supervisor and handler certificates for all workers engaged in the project;

c. Copies of all project notifications and reports filed with DEP and NYSDOL for the project, with any amendments or variances;

d. Copies of all asbestos abatement permits, including associated approved plans and work place safety plan;

e. A copy of the air sampling log and all air sampling results;

f. A copy of the abatement asbestos abatement contractor's daily log book;

g. All data related to bulk sampling including the results of any asbestos surveys performed by an asbestos investigator;

h. Copies of all asbestos waste manifests;

i. A copy of all Project Monitor's Reports (ACP-15).

j. A copy of each ATR-1 Form completed for the asbestos project (if required).

k. A copy of each Asbestos Project Conditional Closeout Report (ACP-20).

l. A copy of the Asbestos Project Completion Form (ACP-21).

9. The asbestos abatement contractor shall submit one of the following certifications to the DOB, with a copy provided to DDC:

a. Asbestos Project Completion Form. If an asbestos project has been performed, a copy of the asbestos project completion form issued by DEP shall be submitted to DOB, with a copy being provided to DDC, prior to the issuance of a DOB permit and to any amendment of the underlying construction document approval which increases the scope of the project to include (a) work area(s) not previously covered.

b. An Asbestos Project Conditional Close-out Form. If an asbestos project has been performed a copy of the asbestos project conditional close-out form issued by DEP shall be submitted to DOB, with a copy being provided to DDC, prior to the issuance of a DOB permit and to any amendment of the underlying construction document approval which increases the scope of the project to include (a) work area(s) not previously covered.

1.10 QUALITY ASSURANCE

A. All work required for the completion of this project or called for in this Specification must be executed in a workmanlike manner by using the appropriate methods established by regulatory requirements and/or industrial standards. All workmanship or work methods are subject to review and acceptance by the Construction Project Manager. Throughout the Specification, reference is made to codes and standards which establish qualities, levels or types of workmanship which will be considered acceptable. It is the asbestos abatement asbestos abatement contractor's responsibility to comply with these codes and standards during the execution of this work.

B. All materials and equipment required or consumed during the work of this Contract must meet the minimum acceptable criteria established by codes and standards referenced elsewhere in this Specification. Materials and equipment must be submitted for prior approval as part of the asbestos abatement contractor's "Shop Drawings".

C. It is the asbestos abatement a contractor's responsibility, when so required by the Specification or upon written request from the Commissioner or his representative to furnish all required proof that workmanship, materials and/or equipment meet or exceed the codes and standards referenced. Such proof shall be in the form requested, typically a certified report or test conducted by a testing entity approved for that purpose by DDC.

D. The asbestos abatement contractor shall furnish proof that employees working under his supervision have had instruction on the dangers of asbestos exposure, on respirator use, decontamination, and OSHA regulations. This proof shall be in the form of a notarized affidavit to the effect that the above requirements have been satisfied.

E. The a asbestos abatement contractor will have at all times in his possession and in view at the job site the OSHA regulations 29 CFR 1910.1001, and 1926.1101 Asbestos, and Environmental Protection Agency 40 CFR, Part 61, subpart B: National Emission Standard for asbestos, asbestos stripping, work practices and disposal of asbestos waste. He shall also have one copy of NYC Title 15, Chapter 1 of RCNY and NYS DOL ICR 56 at the job site at all times.

F. Familiarity with Pertinent Codes and Standards: In procuring all items used in this work, it is the a asbestos abatement contractor's responsibility to verify the detailed requirements of the specifically named codes and standards and to verify that the items procured for use in this work meet or exceed the specified requirements, and are suitable for their intended use.

G. Rejection of Non Complying Items: The Commissioner reserves the right to reject items incorporated into the work that fail to meet the specified minimum requirements. The Commissioner further reserves the right, and without prejudice to other recourse that maybe taken, to accept non-complying items subject to an adjustment in the Contract amount as approved by the City.

H. Applicable Regulations, Codes and Standards: Applicable standards listed in these Specifications include, but are not necessarily limited to, standards promulgated by the following agencies and organizations:

1. American National Standards Institute (ANSI)
(Successor to USASI and ASA)
25 West 43rd Street (between 5th and 6th Avenue) 4th Floor
New York, NY 10036
212-642-4900

2. American Society for Testing and Materials (ASTM)
100 Bar Harbor Drive
West Conshohocken, PA 19428-2959
610-832-9500

3. National Institute for Occupational Safety and Health (NIOSH)
Robert A. Taft Laboratory
4676 Columbia Pkwy
Mailstop R12 Cincinnati, Ohio 45226
513-841-4428

4. National Electrical Code (NEC)
See NFPA

5. National Fire Protection Association (NFPA)
1 Batterymarch Park
Quincy, Massachusetts 02169-7471
617-770-3000

6. New York City Fire Department (FDNY)
9 Metrotech Center
Brooklyn, NY 11201-5431
718-999-2117

7. New York City Department of Buildings (NYC DOB)
   Enforcement Division
   280 Broadway, New York, New York 10007
   212- 566-2850

8. New York City Department of Environmental Protection (NYCDEP)
   Bureau of Environmental Compliance
   Asbestos Control Program
   59-17 Junction Boulevard, 8th Floor
   Corona, New York 11368
   718-595-3682

9. New York City Department of Health and Mental Hygiene (NYC DOHMH)
   Environmental Investigation
   125 Worth Street
   New York, New York 10013
   212-442-3372

10. New York State Department of Labor (NYSDOL)
    Division of Safety and Health
    Engineering Services Unit
    State Office Building Campus
    Albany, New York 12240-0010

11. New York City Department of Sanitation
    125 Worth Street, Room 714
    New York, New York 10013
    212-566-1066

12. Occupational Safety and Health Administration (OSHA)
    Region II - Regional Office
    201Varick Street, Room 908
    New York, New York 10014
    212-337-2378

13. United States Environmental Protection Agency (EPA or USEPA)
    Region II
    Asbestos NESHAPS Contact
    Air and Waste Management Division
    (Air Compliance Branch) – USEPA
    290 Broadway, 21st Floor
    New York, New York 10007-1866
    212-637-3660

I. Post all applicable regulations in a conspicuous place at the job site. Assure that the regulations are not altered, defaced or covered by other materials. One copy of each regulation must also be kept at the Asbestos abatement contractor's office.

1.11 CITY/ASBESTOS ABATEMENT CONTRACTOR RESPONSIBILITIES

A. The normal occupants of the Work Areas will be relocated by the City prior to the performance of the abatement work and returned there to at the conclusion of the abatement work, at no cost to the asbestos abatement contractor. However, the asbestos abatement contractor shall protect all furniture and equipment in the Work Areas in a manner as hereinafter specified. In addition, the asbestos abatement contractor shall perform the work of this Contract in a manner that will be least disruptive to the normal use of the non-Work Areas in the building.

B. Asbestos abatement contractor shall be responsible for cleaning all portable items not specifically addressed by the Facility, in the Work Areas, or dispose of same as asbestos contaminated waste.

C. Facility to provide asbestos abatement contractor with a list of items that cannot be removed and need special attention.

D. Facility to stop all deliveries that may be scheduled to the Work Area while work is in progress.

E. Facilities to have authorized personnel on site at all times or supply the asbestos abatement contractor with means of contacting such personnel without unreasonable delay. Such personnel shall have access to all areas, have knowledge of electrical, and air handling equipment. Such personnel shall assist the asbestos abatement contractor in case of any power failure or breakdown to shut down air supply systems, to reset and control all protective systems such as alarms, sprinklers, locks, etc. The Facility shall ensure no active air handling systems are operating within the Work Area.

F. City will not occupy the portions of the building, in which work is being performed during the entire asbestos removal operation, including completion of clean up.

G. Asbestos abatement contractor shall provide a plan for 24 hour job security both for prevention of theft and for barring entry of curious but unprotected personnel into Work Areas.

H. Asbestos abatement contractor shall provide surveillance by a fire watch and set forth procedures to be taken for the safety of building occupants in the event of an emergency, in accordance with the WPSP.

I. Should the failure of any utility occur, the City will not be responsible to the asbestos abatement contractor for loss of time or any other expense incurred.

J. Facility will be responsible to notify the asbestos abatement contractor of any planned electrical power shutdowns in order to ensure that there are no power interruptions in the negative air pressure systems.

K. Asbestos abatement contractor shall remove all flammable materials from the work area and all sources of ignition (including but not limited to pilot lights) shall be extinguished.

L. Asbestos abatement contractor shall require a competent person (as defined in OSHA 1926.1101) to perform the following functions and to be on-site continuously for the duration of the project:

1. Monitor the set up of the Work Area enclosure and ensure its integrity.

2. Control entry and exit into the work enclosure.

3. Ensure that employees are adequately trained in the use of engineering controls, proper work practices, proper personal protective equipment and in decontamination procedures.

4. Insure that employees use proper engineering controls, proper work practices, proper personal protective equipment and proper decontamination procedures.

5. The competent person (as defined in OSHA1926.1101) shall check for rips and tears in work suits, and ensure that they are mended immediately or replaced.

1.12 USE OF BUILDING FACILITIES

A. City shall make available to the asbestos abatement contractor, from existing outlets and supplies, all reasonably required amounts of water and electric power at no charge.

B. Electric power to all Work Areas shall be shut down and locked out except for electrical equipment that must remain in service. Safe temporary power and lighting shall be provided by asbestos abatement contractor in accordance with applicable codes. All power to Work Areas shall be brought in from outside the area through ground-fault interrupter circuits installed at the source. Stationary electrical equipment within the Work Area, which must remain in service, shall be adequately protected, enclosed and ventilated. The Facility will identify all electric lines that must remain in service. Asbestos abatement contractor shall protect all lines.

C. Asbestos abatement contractor shall provide, at his own expense, all electrical, water, and waste connections, tie-ins, extensions, and construction materials, supplies, etc. All water tie-ins shall be hard piped with polyethylene or copper piping. At the end of each shift, asbestos abatement contractor shall disconnect all hoses within the work zone and place in equipment room of the worker decontamination unit. Asbestos abatement contractor shall ensure positive shutoff of all water to Work Area during non-working hours.

D. Utilities:

1. General:
All temporary facilities required to be installed, shall be subject to the approval of the Commissioner. Prior to starting the work at any site; specify clearly the temporary locations of facilities preferably with sketches and submit the same to the Construction Project Manager for approval.

2. Water:
The Department of Design and Construction will furnish all water needed for construction, at no cost to the asbestos abatement contractor in buildings under their jurisdiction. All temporary plumbing or adaptations to supply the needs of the Work Area shall be installed and removed by the asbestos abatement contractor and the cost thereof included in the Lump Sum price for abatement work. Shower water for the decontamination unit shall be provided hot. Heating of water, if necessary, shall be provided by the asbestos abatement contractor.

3. Electricity:
The Department of Design and Construction will furnish all electricity needed for construction, at no cost to the asbestos abatement contractor in buildings under their jurisdiction. All temporary electrical work or adaptations to supply the needs of the Work Area shall be installed and removed by the asbestos abatement contractor and the cost thereof included in the Lump Sum price for abatement work.

In leased spaces, arrangements for water supplies and electricity must be made with the landlord. However, all such arrangements must be made through and are subject to approval of the Department of Design and Construction. Utilities will be provided at no cost to the Asbestos abatement contractor. However, it is the asbestos abatement contractor's (or the General contractor's) responsibility to furnish and install a suitable distribution system to the Work Area. This system will be provided at no cost to the City.

A dedicated power supply for the negative pressure ventilating units shall be utilized. The negative air equipment shall be on a ground fault circuit interrupter (GFCI) protected circuit separate from the remainder of the work area temporary power circuits.

E. Asbestos abatement contractor shall shut down and lock out all electric power to all work areas except for electrical equipment that must remain in service. Safe temporary power and lighting shall be provided in accordance with all applicable codes. Existing light sources (e.g., house lights) shall not be utilized. All power to work areas shall be brought in from outside the area through ground-fault circuit interrupter at the source.

1. If electrical circuits, machinery, and other electrical systems in or passing though the work area must stay in operation due to health and safety requirements, the following precautions must be taken:

   a. All unprotected cables, except low-voltage (less than 24 volts) communication and control system cables, panel boxes of cables and joints in live conduit that run through the work area shall be covered with three (3) independent layers of six (6) mil fire retardant polyethylene. Each layer shall be individually duct taped and sealed. All three (3) layers of polyethylene sheeting shall be left in place until satisfactory clearance air sampling results have been obtained.

   b. Any energized circuits remaining in the work area shall be posted with a minimum two (2) inch high lettering warning sign which reads: DANGER LIVE ELECTRICAL - KEEP CLEAR. A sign shall be placed on all live covered barriers at a maximum of ten (10) foot intervals. These signs shall be posted in sufficient numbers to warn all persons authorized to enter the work area of the existence of the energized circuits.

2. Any source of emergency lighting which is temporarily blocked as a result of work place preparation shall be replaced for the duration of the project by battery operated or temporary exit signs, exit lights, or photo luminescent path markings.

F. Asbestos abatement contractor shall provide a separate temporary electric panel board to power asbestos abatement contractor's equipment. The Facility will designate an existing electrical source in proximity to the Work Area. Asbestos abatement contractor's licensed electrician shall provide temporary tie-in via cable, outlet boxes, junction boxes, receptacles and lights, all with ground fault interruption. At no time shall extension cords greater than 50-feet in length be allowed. All temporary electrical installation shall be in accordance with OSHA regulations. The electric shut down for power panel tie-in will be on off-hours and must be coordinated with the Facility. Asbestos abatement contractor shall provide to the City a specification and drawing outlining his power requirements at the pre-construction meeting.

G. Additional electrical equipment (i.e., transformers, etc.), which is necessary due to the lack of existing power on the floor, shall be at the asbestos abatement contractor's expense.

H. Asbestos abatement contractor shall provide fire protection in accordance with all State and Local fire codes.

I. Sprinklers, standpipes, and other fire suppression systems shall remain in service and shall not be plasticized.

J. When temporary service lines are no longer required, they shall be removed by the asbestos abatement asbestos abatement contractor. Any parts of the permanent service lines, grounds and buildings, disturbed or damaged by the installation and/or removal of the temporary service lines, shall be restored to their original condition by the asbestos abatement asbestos abatement contractor. Senior Stationary Engineer will inspect and test all switches, controls, gauges, etc. and shall submit a list to the Construction Project Manager of any equipment damaged by the asbestos abatement asbestos abatement contractor.

K. Asbestos abatement contractor shall supply hot shower water necessary for use in the decontamination unit.

1.13 USE OF THE PREMISES

A. Asbestos abatement contractor shall confine his apparatus, the storage of materials, and supplies, and the operation of his workmen to limits established by law, ordinances, and the directions of the Construction Project Manager and the Facility. All flammable or combustible materials shall be properly stored to obviate fire and in areas approved by the Facility.

B. Asbestos abatement contractor shall assure that no exits from the building are obstructed, that appropriate safety barriers are established to prevent access, and that Work Areas are kept neat, clean, and safe.

C. Asbestos abatement contractor shall maintain exits from the work area or alternative exits shall be established, in accordance with section 1027 of the New York City Fire Code. Exits shall be checked at the beginning and end of each work shift against blockage or impediments to exiting.

D. If the openings of temporary structural partitions related to abatement work areas block egress, the partition shall consist of two sheets of fire retardant 6-mil plastic, prominently marked as an exit with photo luminescent paint or signage. Cutting tools (e.g., knife, razor) shall be attached to the work area side of the sheeting for use in the event that the barrier must be cut open to allow egress.

E. All surrounding work, fixtures, soil lines, drains, water lines, gas pipes, electrical conduit, wires, utilities, duct work railings, shrubbery, landscaping, etc. which are to remain in place shall be carefully protected and, if disturbed or damaged, shall be repaired or replaced as directed by the City, at no additional cost.

F. All routes through the building to be used by the asbestos abatement contractor shall first be approved by the Construction Project Manager and the Facility.

G. Attention is specifically drawn to the fact that other asbestos abatement contractors, performing the work of other Contracts, may be (or are) brought upon any of the work sites of this Contract. Therefore, the asbestos abatement contractor shall not have exclusive rights to any site of his work and shall fully cooperate and coordinate his work with the work of other asbestos abatement contractors who may be on (or are on) any site of the work of this Contract. Regulated area exempted.

H. Temporary toilet facilities must be provided by the asbestos abatement contractor on the site. Coordinate location of facilities with Construction Project Manager. No toilet facilities will be allowed in the Work Area.

1.14 PROTECTION AND DAMAGE

A. The asbestos abatement contractor is responsible to cover all furniture and equipment that cannot be removed from Work Areas. Moveable furniture and equipment will be removed from Work Areas by asbestos abatement contractor prior to start of work and returned upon successful completion of the final air testing. At the conclusion of the work (after clearance level of air testing reaches the acceptable limit), the asbestos abatement contractor will remove all plastic covering from the walls, floors, furniture, equipment and reinstall furniture and equipment in the cleaned Work Area. The asbestos abatement contractor shall remove all shades, curtains and drapes from the Work Area, and reinstall the same following the final clean up.

B. Prior to plasticizing, the proposed work areas shall be pre-cleaned using HEPA filtered vacuum equipment and/or wet cleaning methods. Methods that raise dust, such as sweeping or vacuuming with equipment not equipped with HEPA filters, are prohibited.

C. Use rubber tired vehicles that use non-volatile fuels for conveying material inside building and provide temporary covering, as necessary, to protect floors.

D. No materials or debris shall be thrown from windows or doors of the building. Building waste system shall NOT be used to remove refuse.

E. Debris shall be removed from the work site daily. Premises shall be left neat and clean after each work shift, so that work may proceed the next regular workday without interruption. Limited bag storage may take place within the Work Area when approved by the Construction Project Manager.

F. Protect floors and walls along removal routes from damage, wear and staining with contamination control flooring. All finished surfaces to be protected with Masonite or other rigid sheathing material.

G. A preliminary inspection for pre-existing damage shall be conducted by asbestos abatement contractor and representative of the City before commencement of the project.

1.15 RESPIRATORY PROTECTION REQUIREMENTS

A. Respiratory protection shall be worn by all individuals who may be exposed to asbestos fibers from the initiation of the asbestos project until all areas have successfully passed clearance air monitoring in accordance with Regulations and these Specifications.

B. Asbestos abatement contractor shall develop and implement a written respiratory protection program with required site-specific procedures and elements. The program shall be administered by a properly trained individual. The written respiratory protection program shall include the requirements set forth in OSHA Standard 29 CFR 1910.134, at a minimum.

C. The Asbestos abatement contractor shall provide workers with individually issued and marked respiratory equipment. Respiratory equipment shall be suitable for the asbestos exposure level(s) in the Work Area(s), as specified in OSHA Standards 26 CFR 1910.134 and 29 CFR 1926.1101, NIOSH Standard 42 CFR 84, or as more stringently specified otherwise, herein.

D. Where respirators with disposable filter parts are employed, the asbestos abatement contractor will provide sufficient filter parts for replacement as necessary or as required by the applicable regulation.

E. All respiratory protection shall be NIOSH approved. All respiratory protection shall be provided by asbestos abatement contractor, and used by workers in conjunction with the written respiratory protection program.

F. Asbestos abatement contractor shall provide respirators selected by an Industrial Hygienist that meet the following requirements:

Table 1. -- Assigned Protection Factors[5]

Type of Respirator[1,2]	Half mask	Full facepiece	Helmet/hood
1. Air-Purifying Respirator	[3]10	50	.....
2. Powered Air-Purifying Respirator (PAPR)	50	1,000	[4]25/1,000
3. Supplied-Air Respirator (SAR) or Airline Respirator			
• Demand mode	10	50	.....
• Continuous flow mode	50	1,000	[4]25/1,000
• Pressure-demand or other positive-pressure mode	50	1,000	.....
4. Self-Contained Breathing Apparatus (SCBA)			
• Demand mode	10	50	50
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	.....	10,000	10,000

Notes:

[1]Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

[2]The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this section (29 CFR 1910.134), including training, fit testing, maintenance, and use requirements.

[3]This APF category includes filtering facepieces, and half masks with elastomeric facepieces.

[4]The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25.

[5]These APFs do not apply to respirators used solely for escape. For escape respirators used in association with specific substances covered by 29 CFR 1910 subpart Z, employers must refer to the appropriate substance-specific standards in that subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).

G. Selection of high efficiency filters:

1. All high efficiency filters shall have a nominal efficiency rating of 100 (99.97-percent effective) when tested against 0.3-micrometer monodisperse diethyl-hexyl phthalate (DOP) particles.

2. Choose N-, R-, or P-series filters based upon the presence or absence of oil particles.

   a. N-series filters shall only be used for non-oil solid and water based aerosols or fumes.

   b. R- and P-series filters shall be used when oil aerosols or fumes (i.e., lubricants, cutting fluids, glycerin, etc.) are present. The R-series filters are oil resistant and the P-series filters are oil proof.

   c. Follow filter manufacture recommendations.

3. If a vapor hazard exists, use an organic vapor cartridge in combination with the high efficiency filter.

H. Historical airborne fiber level data may serve as the basis for selection of the level of respiratory protection to be used for an abatement task. Historical data provided by the asbestos abatement contractor shall be based on personal air monitoring performed during work operations closely resembling the processes, type of material, control methods, work practices, and environmental conditions present at the site. Documentation of aforementioned results may be requested by the City and/or Third-Party Air Monitor for review. This will not relieve the asbestos abatement contractor from providing personal air monitoring to determine the time-weighted average (TWA) for the work under contract. The TWA shall be determined in accordance with 29 CFR 1926.1101.

I. At no time during actual removal operations shall half-mask air purifying respirators be allowed unless a full 8-hour TWA and excursion limit have been conducted, and reviewed by the Construction Project Manager. If the TWA and excursion limit have not been conducted, a Supplied-Air Respirator (SAR) or Airline Respirator or Self-Contained Breathing Apparatus (SCBA) must be used. Use of single use dust respirators is prohibited for the above respiratory protection.

J. Workers shall be provided with personally issued and individually marked respirators. Respirators shall not be marked with any equipment that will alter the fit of the respirator in any way. Only waterproof identification markers shall be used.

K. Asbestos abatement contractor shall ensure that the workers are qualitatively or quantitatively fit tested by an Industrial Hygienist initially and every 12 months thereafter with the type of respirator he/she will be using.

L. Whenever the respirator design permits, workers shall perform the positive and negative air pressure fit test each time a respirator is worn. Powered air-purifying respirators shall be tested for adequate flow as specified by the manufacturer.

M. No facial hairs (beards) shall be permitted to be worn when wearing respiratory protection that requires a mask-to-face seal.

N. If a worker wears glasses, a spectacle kit to fit their respirator shall be provided by the asbestos abatement contractor at the asbestos abatement contractor's expense.

O. Respiratory protection maintenance and decontamination procedures shall meet the following requirements:

1. Respiratory protection shall be inspected and decontaminated on a daily basis in accordance with OSHA 29 CFR 1910.134 (b); and

2. High efficiency filters for negative pressure respirators shall be changed after each shower; and

3. Respiratory protection shall be the last piece of worker protection equipment to be removed. Workers must wear respirators in the shower when going through decontamination procedures as stated in Section 3.03 and/or 3.04.

4. Airline respirators with high efficiency filtered disconnect shall be disconnected in the equipment room and worn into the shower. Powered air-purifying respirator face pieces shall be worn into the shower. Filtered/power pack assemblies shall be decontaminated in accordance with manufacturers recommendations; and

5. Respirators shall be stored in a dry place and in such a manner that the face-piece and exhalation valves are not distorted; and

6. Organic solvents shall not be used for washing of respirators.

P. Authorized visitors shall be provided with suitable respirators and instruction on the proper use of respirators whenever entering the Work Area. Qualitative fit test shall be done to ensure proper fit of respirator.

1.16 PROTECTIVE CLOTHING

A. Provide worker protection as required by the most stringent OSHA and/or EPA standards applicable to the work. Provide to all workers, foremen, superintendents, authorized visitors and inspectors, protective disposable clothing consisting of full body coveralls, head covers, gloves and 18-inch high boot type covers or reusable footwear.

B. In addition to personal protective equipment for workers, the asbestos abatement contractor shall make available at each worksite at least four (4) additional uniforms and required respiratory equipment each day for personnel who are authorized to inspect the work site. He/she shall also provide, for the duration of the work at any site involving a decontamination unit for worksite access, a lockable storage locker for use by the Construction Project Manager. In addition to respiratory masks for workers, the asbestos abatement contractor must have on hand at the beginning of each work day, at least four (4) masks each with two sets of fresh filters, for use by personnel who are authorized to inspect the worksite. The asbestos abatement contractor shall check for proper fit of the respirators of all City personnel authorized to enter the Work Area.

C. Asbestos handlers involved in tent procedures shall wear two (2) disposable suits, including gloves, hood and footwear, and appropriate respiratory equipment. All street clothes shall be removed and stored in a clean room within the work site. The double layer personal protective equipment shall be used for installation of the tent and throughout the procedure, if a decontamination unit (with shower and clean room) is contiguous to the Work Area, only one (1) layer of disposable personal protective equipment shall be required; in this case, prior to exiting the tent the worker shall HEPA vacuum and wet clean the disposable suit.

D. The outer disposable suit (if 2 suits are worn) shall be removed and remain in the tent upon exiting. Following the tent disposal and work site clean up the workers shall immediately proceed to a shower at the work site. The inner disposal unit and respirator shall be removed in the shower after appropriate wetting. The disposal clothing shall be disposed of as asbestos-containing waste material. The workers shall then fully and vigorously shower with supplied liquid bath soap, shampoo, and clean dry towels.

E. Coveralls: provide disposable full-body coveralls and disposable head covers. Require that they be worn by all workers in the Work Area. Provide a sufficient number for all required changes for all workers in the Work Area.

F. Boots: provide work boots with non-skid soles, and where required by OSHA, foot protection, for all workers. Provide boots at no cost to workers. Paint uppers of all boots yellow with waterproof enamel. Do not allow boots to be removed from the Work Area for any reason after being contaminated with ACM and/or dust.

G. Hard Hats: provide hard hats as required by OSHA for all workers, and provide a minimum of four spares for Inspectors, visitors, etc. Label all hats with same warning label as used on disposal bags. Require hard hats to be worn at all times that work is in progress that may cause potential head injury. Provide hard hats of the type with polyethylene strap suspension. Require hats to remain in the Work Area throughout the work. Thoroughly clean and decontaminate and bag hard hats prior to removing them from the Work Area at the end of the work.

H. Goggles: provide eye protection (goggles) as required by OSHA for all workers involved in any activity that may potentially cause eye injury. Require them to be worn at all times during these activities. Thoroughly clean and decontaminate goggles before removing them from the Work Area.

I. Gloves: provide work gloves to all workers, of the type dictated by the Work and OSHA Standards. Do not remove gloves from the Work Area. Dispose of as asbestos-asbestos contaminated waste at the end of the work. Gloves shall be worn at all times, except during Work Area Preparation activities that do not disturb ACM.

J. Reusable footwear, hard hats and eye protection devices shall be left in the contaminated Equipment Room until the end of the Asbestos Abatement Work.

K. Disposable protective clothing shall be discarded and disposed of as asbestos waste every time the wearer exits from the workspace to the outside through the decontamination facility.

L. Respirators, disposable coveralls, head covers and foot covers shall be provided by the asbestos abatement contractor for the Facilities Representative, Construction Project Manager and any other authorized representative who may inspect the Work Area. Provide two respirators and six respirator filter changes per day.

1.17 AIR MONITORING - ASBESTOS ABATEMENT CONTRACTOR

A. Asbestos abatement contractor shall employ a qualified industrial hygiene laboratory to analyze air samples in accordance with OSHA Regulations, 1926.1101 (Asbestos Standards for Construction) and New York City regulations.

B. The industrial hygiene laboratory shall be a current proficient participant in the American Industrial Hygiene Association (AIHA) PAT Program. The laboratory identification number shall be submitted and approved by the City. The laboratory shall be accredited by the AIHA and New York State Department of Health Environmental Laboratory Approval Program (ELAP).

C. Industrial hygiene laboratory shall also be a current proficient participant in the NIST/NVLAP Quality Assurance Program for the identification of bulk samples. Laboratory identification number shall be submitted to and approved by the City.

D. Air monitoring responsibilities for the asbestos abatement contractor's employees, shall be performed by a representative of the industrial hygiene laboratory retained by the asbestos abatement contractor.

E. Asbestos abatement contractor shall submit to the City all credentials of the designated (as defined in OSHA 1926.1101) and industrial hygiene laboratory representative for approval.

F. Air monitoring and inspection shall be conducted by the Asbestos abatement contractor's competent person (as defined in OSHA 1926.1101).

G. Continuous (daily or per shift) monitoring and inspection will include Work Area samples, personnel samples from the breathing zone of a worker to accurately determine the employees' 8-hour TWA (unless Type C respirators are used) and decontamination unit clean room samples.

H. Work Area samples and employee personnel samples shall be taken using pumps whose flow rates can be determined to an accuracy of +5-percent, at a minimum of two liters per minute. This must be demonstrated at the job site.

I. Sampling and analysis methods shall be per NIOSH 7400A.

J. Test Reports:

1. Promptly process and distribute one copy of the test results, to the Commissioner.

2. Prompt reports are necessary so that if required, modifications to work methods and/or practices may be implemented as soon as possible.

3. Asbestos abatement contractor shall by facsimile notify the Commissioner within 24 hours of the results of each test, followed by written notification within three days.

K. Competent person shall conduct inspections and provide written reports daily. Inspections will include checking the standard operating procedures, engineering control systems, respiratory protection and decontamination systems, packaging and disposal of asbestos waste, and any other aspects of the project which may affect the health and safety of the people and environment.

L. All costs for required air monitoring by the asbestos abatement contractor's competent person shall be borne by the asbestos abatement contractor.

M. The City reserves the right to conduct air and surface dust sampling in conjunction with and separate from the Third-Party Air Monitor for the purposes of Quality Assurance.

N. All samples shall be accompanied by a Chain of Custody Record that shall be submitted to the Construction Project Manager upon completion of analysis.

1.18 THIRD PARTY MONITORING AND LABORATORY

A. The NYCDDC, at its own expense, will employ the services of an independent Third Party Air Monitoring Firm and Laboratory. The Third Party Air Monitor will perform air sampling activities and project monitoring at the Work Site.

B. The Laboratory will perform analysis of air samples utilizing Phase Contrast Microscopy (PCM) and/or Transmission Electron Microscopy (TEM). This laboratory shall meet the standards stated in Paragraph 1.17. B.

C. Observations will include, but not be limited to, checking the standard operating procedures, engineering control systems, respiratory protection, decontamination systems, packaging and disposal of asbestos waste, and any other aspects of the project that may affect the health and safety of the environment, Asbestos abatement contractor, and/or facility occupants.

D. The Third Party Air Monitoring Firm and the designated Project Monitor shall have access to all areas of the asbestos removal project at all times and shall continuously inspect and monitor the performance of the asbestos abatement contractor to verify that said performance complies with this Specification. The Third-Party Air Monitor shall be on site throughout the entire abatement operation.

E. The NYCDDC will be responsible for costs incurred with the Third Party Air Monitoring Firm and laboratory work. Any subsequent additional testing required due to limits exceeded during initial testing shall be paid for by the Asbestos abatement contractor.

F. At a minimum, air sampling shall be conducted in accordance with the following schedule:

Abatement Activity	**Pre-Abatement**	**During Abatement**	**Post-Abatement**
Equal to or greater than 10,000 square feet or 10,000 linear feet of ACM	PCM	PCM	TEM
Less than 10,000 square feet or 10,000 linear feet of ACM	PCM	PCM	PCM

Note: TEM is acceptable wherever PCM is required.

G. The number of air samples required per stage of abatement and size of abatement project is listed in the table below:

		Pre-Abatement	During Abatement	Post Abatement
	Large Asbestos Projects			
1.	Full Containment	10	5	10
2.	Glovebag inside Tent	5[a]	5[a]	5[a]
3.	Exterior Foam and Vertical Surfaces	-	5[c]	5[d]
4.	Interior Foam	10	5[c]	10[d]

		Pre-Abatement	During Abatement	Post Abatement
	Small Asbestos Projects			
1.	Full Containment	6	3	6
2.	Glovebag inside Tent	3[b]	3[b]	3[b]
3.	Tent	3[b]	3[b]	3[b]
4.	Exterior Foam and Vertical Surfaces	-	3[c]	3[d]
5.	Interior Foam	6	3[c]	6[d]
	Minor Projects			
1.	Glovebag inside Tent	-	-	1[d]
2.	Tent	-	-	1[d]
3.	Exterior Foam and Vertical Surfaces	-	-	1[d]
4.	Interior Foam	-	-	1[d]

Notes:

a. if more than three (3) tents then two (2) samples required per enclosure.
b. if more than three (3) tents then one (1) sample required per enclosure.
c. samples shall be taken within the work area(s).
d. area sampling is required only if:
   - visible emissions are detected during the project
   - during-abatement area sampling results exceeded 0.01 f/cc or the pre-abatement area sampling result(s) for interior projects where applicable.
   - work area to be reoccupied is an interior space at a school, healthcare, or daycare facility.

H. Prior to commencement of abatement activities, the Third Party Air Monitoring Firm will collect a minimum number of area samples inside each homogeneous work area.

1. Samples will be taken during normal occupancy activities and circumstances at the work site.

2. Samplers shall be located within the proposed work area and at all proposed isolation barrier locations.

3. Samples shall be analyzed using PCM.

4. The number of samples to be collected will be determined by the size of the project and the abatement methods to be utilized.

I. Frequency and duration of the air sampling during abatement shall be representative of the actual conditions during the abatement. The size of the asbestos project will be a factor in the number of samples required to monitor the abatement activities. The following minimum schedule of samples shall be required daily.

1. For large asbestos projects employing full containment, area air sampling shall be performed at the following locations:

a. Two area samples outside the work area in uncontaminated areas of the building, remote from the decontamination facilities.

(1) Primary location selection shall be within 10 feet of isolation barriers.

(2) Where negative ventilation exhaust runs through uncontaminated building areas, one of the area samples will be required in these areas to monitor any potential fiber release.

(3) Where exhaust tubes have been grouped together in banks of up to five (5) tubes, with each tube exhausting separately and the bank of tubes terminating together at the same controlled area, one area air sample shall be taken.

b. One area sample within the uncontaminated entrance to each decontamination enclosure system.

c. Where adjacent non-work areas do not exist, an exterior area sample shall be taken.

d. One area sample within 5 feet of the unobstructed exhaust from a negative pressure ventilation system exhausting indoors but not within a duct.

e. One area sample outside, but within 25 feet of, the building or structure, if the entire building or structure is the work area.

2. For large asbestos projects involving interior foam method, area air sampling shall be performed at the following sampling locations:

a. One area sample taken outside the work area within 10 feet of isolation barriers.

b. One area sample taken within the uncontaminated entrance to each worker decontamination and waste decontamination enclosure system.

c. One area sample within 5 feet of the unobstructed exhaust from a negative pressure ventilation system exhausting indoors but not within a duct, if applicable.

d. Three area samples inside the work area.

e. One area sample where the negative ventilation exhaust ducting runs through uncontaminated building areas, if applicable.

3. For large asbestos projects employing the glovebag procedure within a tent, a minimum of five continuous air samples shall be taken concurrently with the abatement for each work area, unless there are more than three enclosures, in which case two area samples per enclosure are required.

a. Four area samples taken outside the work area within ten feet of tent enclosure(s).

b. One area sample taken within the uncontaminated entrance to each worker and waste decontamination enclosure system.

c. One area sample within five feet of the unobstructed exhaust from a negative pressure ventilation system exhausting indoors, but not within a duct, if applicable.

d. One area sample where negative ventilation exhaust ducting runs through uncontaminated building areas, if applicable.

4. For large asbestos projects involving exterior foam method or removal of ACM from vertical surfaces, a minimum of five continuous area samples shall be taken concurrently with the abatement for each work area using the following minimum requirements:

a. Three area samples inside the work area and remote from the decontamination systems.

b. One area sample within the uncontaminated entrance to each worker and waste decontamination enclosure system.

c. One area sample outside the work area within 25 feet of the building or structure, if the entire building or structure is the work area.

d. One area sample inside the building or structure at the egress point to the work area, if applicable.

5. For small asbestos projects employing full containment, a minimum of three continuous area samples shall be taken concurrently with the abatement for each work area at the following locations:

a. Two area samples taken outside the work area within ten feet of the isolation barriers.

b. One area sample within the uncontaminated entrance to each worker or waste decontamination enclosure system.

c. One area sample within five feet of the unobstructed exhaust from a negative pressure ventilation system exhausting indoors, but not within a duct, if applicable.

d. One area sample where negative ventilation exhaust ducting runs through an uncontaminated building area, if applicable.

6. Tent Procedures:
For projects involving more than 25 linear feet or 10 square feet, a minimum of three continuous samples shall be taken concurrently throughout abatement.

J. Post-abatement clearance air monitoring for projects not solely employing glove-bag procedures shall include a minimum number of area samples inside each homogeneous work area and outside each homogeneous work area (five samples inside/five samples outside for Large Projects and three samples inside/three samples outside for Small Projects). In addition to the five sample inside/five sample outside minimum for Large Projects, one additional representative area sample shall be collected inside and outside the work area for every 5,000 square feet above 25,000 square feet of floor space where ACM has been abated.

K. Post-abatement clearance air monitoring for Small Projects solely employing glove-bag procedures is not required unless one or more of the following events occurs. In such cases, post-abatement clearance air monitoring procedures shall be followed. The events requiring post-abatement clearance air monitoring are:

1. The integrity of the glove-bag was compromised,

2. Visible emissions are detected outside the glove-bag, and/or

3. Ambient levels exceed 0.01 f/cc during abatement.

L. Monitoring requirements for other than post-abatement clearance air monitoring are as follows:

1. The sampling zone for indoor air samples shall be representative of the building occupants' breathing zone.

2. If possible, outdoor ambient and baseline samplers should be placed about 6 feet above the ground surface in reasonable proximity to the building and away from obstructions and drafts that may unduly affect airflow.

3. For outdoor samples, if access to electricity and concerns about security dictate a rooftop site, locations near vents and other structures on the roof that would unduly affect airflow shall be avoided.

4. Air sampling equipment shall not be placed in corners of rooms or near obstructions such as furniture.

5. Samples shall have a chain of custody record.

M. Area air sampling during abatement shall be conducted as specified in the following documents except as restricted or modified herein:

1. Measuring Airborne Asbestos Following an Abatement Action, US EPA document 600/4-85-049 (Nov., 1985);

2. Guidance for Controlling Asbestos-Containing Materials in Buildings; US EPA Publication 560/5-85- 024 (June, 1984);

3. Methodology for the Measurement of Airborne Asbestos by Electron Microscopy US EPA Contract No. 68-02- 3266;

4. Mandatory and non-mandatory Electron Microscopy Methods set forth in 40 CFR Part 763, Subpart E, Appendix A.

5. NIOSH 7400 method using "A" counting rules

N. In accordance with the above criteria, area samples (see NYCDEP Asbestos Control Program Regulations) shall conform to the following schedule:

Area Samples for Analysis by	Minimum Volume	Flow Rate
PCM, 25mm cassettes	560 liters	5 to 15 liters/minute
TEM, 25mm cassettes	560 liters	1 to 10 liters/minute
TEM, 37mm cassettes	1,250 liters	1 to 10 liters/minute

O. Post-abatement clearance air monitoring requirements are as follows:

1. Sampling shall not begin until at least one hour after wet cleaning has been completed and no visible pools of water or condensation remain.

2. Samplers shall be placed at random around the work area. If the work area contains the number of rooms equivalent to the number of required samples based on floor area, a sampler shall be placed in each room. When the number of rooms is greater than the required number of samples, a representative sample of rooms shall be selected.

3. The representative samplers placed outside the work area but within the building shall be located to avoid any air that might escape through the isolation barriers and shall be approximately 50 feet from the entrance to the work area, and 25 feet from the isolation barriers.

P. The following aggressive sampling procedures shall be used within the work area during all clearance air monitoring:

1. Before starting the sampling pumps, use forced air equipment (such as a one horsepower leaf blower) to direct exhaust air against all walls, ceilings, floors, ledges and other surfaces in the work area. This pre-sampling procedure shall take at least five minutes per 1,000 square feet of floor area; then

2. Place a 20-inch diameter fan in the center of the room. Use one fan per 10,000 cubic feet of room space. Place the fan on slow speed and point it toward the ceiling.

3. Start the sampling pumps and sample for the required time or volume.

4. Turn off the pump and then the fan(s) when sampling is completed.

5. Collect a minimum number of area samples inside and outside each homogeneous work area (five inside/five outside samples for Large Projects and three inside/three outside samples for Small Projects). In addition to the minimum for Large Projects, one representative area samples shall be collected inside and outside the work area for every 5,000 square feet above 25,000 square feet of floor space where ACM has been abated.

Q. For post-abatement monitoring, area samples shall conform to the following schedule:

Area Samples for Analysis by	Minimum Volume	Flow Rate
PCM	1,800 liters	5 to 15 liters/minute
TEM	1,250 liters	1 to 10 liters/minute

1. Each homogeneous work area that does not meet the clearance criteria shall be thoroughly re-cleaned using wet methods, with the negative pressure ventilation system in operation. New samples shall be collected in the work area as described above. The process shall be repeated until the work site meets the clearance criteria.

2. For an asbestos project with more than one homogeneous work area, the release criterion shall be applied independently to each work area.

3. Should airborne fiber concentrations exceed the clearance criteria, the asbestos abatement contractor shall re-clean the work area utilizing wet wiping and HEPA-vacuuming techniques. Following completion of re-cleaning activities, the Third-Party Air Monitor will perform an observation of the Work Area. If the Third-Party Air Monitor determines that the work was performed in accordance with the specifications, the appropriate settling period will be observed and additional air sampling will be performed.

4. All costs resulting from additional air tests and observations shall be borne by the asbestos abatement contractor. These costs may include, but are not limited to, labor, analysis fees, materials, and expenses.

5. After the area has been found to be in compliance, the asbestos abatement contractor may remove Isolation Barriers and perform final cleaning as specified.

R. Clearance and/or Re-occupancy Criteria:

1. The clearance criteria shall be applied to each homogeneous work area independently.

2. For PCM analysis, the clearance air monitoring shall be considered satisfactory when each of the 5 inside/5 outside samples for Large Projects and/or 3 inside/3 outside samples for Small Projects is less than or equal to 0.01 f/cc or the background concentrations, whichever is greater.

3. For TEM analysis, the clearance air monitoring shall be considered satisfactory when the requirements stated in 40 CFR Part 763, Subpart E, Appendix A, Section IV are met.

4. As soon as the air monitoring tests are completed, the Third-Party Air Monitor will send the results of such tests to the City and notify the Asbestos abatement contractor.

5. The asbestos abatement contractor shall initiate the appropriate closeout information into the DEP ARTS database within 24 hours of work area completion to allow the Third Party Air Monitoring Firm to complete and submit the ACP-15 forms for each specific work area.

6. The asbestos abatement contractor shall provide the ACP-20 and ACP-21 forms to the Third Party Air Monitoring Firm within 48 hours of receipt.

1.19 TAMPERING WITH TEST EQUIPMENT

All parties to this Contract are hereby notified that any tampering with testing equipment will be considered an attempt at falsifying reports and records to federal and state agencies and each offense will be prosecuted under applicable state and federal criminal codes to the fullest extent possible.

1.20 GUARANTEE

A. Work performed in compliance with this Contract shall be guaranteed for a period of one year from the date the completed work is accepted by the City.

B. The asbestos abatement contractor shall not be held liable for the guarantee where the repair required under the guarantee is a result of obvious abuse or vandalism, as determined by the Commissioner.

C. The City will notify the asbestos abatement contractor in writing regarding defects in work under the guarantee.

PART 2 – PRODUCTS

2.01 MATERIAL HANDLING

A. Deliver all materials to the job site in their manufacturer's original container, with the manufacturer's label intact and legible.

1. Maintain packaged materials with seals unbroken and labels intact until time of use.

2. Store all materials on pallets, away from any damp and/or wet surface. Cover materials in order to prevent damage and/or contamination.

3. Promptly remove damaged materials and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the City.

B. The Construction Project Manager may reject as non-complying such material and products that do not bear identification satisfactory to the Construction Project Manager as to manufacturer, grade, quality and other pertinent information.

2.02 MATERIALS

A. Wetting agents: (Surfactant) shall consist of resin materials in a water base, which have been tested to ensure materials are non-toxic and non-hazardous. Surfactants shall be installed according to the manufacturer's written instructions.

B. Encapsulants: Liquid material which can be applied to asbestos-containing material which temporarily controls the possible release of asbestos fibers from the material or surface either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant). A thin coat of lockdown encapsulant shall be applied to all surfaces in the work area which were not the subject of removal or abatement, including the cleaned layer of the surface barriers, but excepting sprinklers, standpipes, and other active elements of the fire suppression system.

C. During abatement activities, replacement materials shall be stored outside the work area in a manner to prevent contamination. Materials required for the asbestos project (i.e., plastic sheeting, replacement filters, duct tape, etc.) shall be stored to prevent damage or contamination.

D. Framing Materials and Doors: As required to construct temporary decontamination facilities and isolation barriers. Lumber shall be high grade, new, finished one side and fire retardant.

E. Fire Retardant Polyethylene Sheeting: minimum uniform thickness of 6-mil. Provide largest size possible to minimize seams. All materials used in the construction of temporary enclosures shall be noncombustible or fire-retardant in accordance with NFPA 701 and 255.

F. Fire Retardant Reinforced Polyethylene Sheeting: For covering floor of decontamination units, provide translucent, nylon reinforced or woven polyethylene laminated, fire retardant polyethylene sheeting. Provide largest size possible to minimize seams, minimum uniform thickness 6-mil. All materials used in the construction of temporary enclosures shall be noncombustible or fire-retardant in accordance with NFPA 701 and 255.

G. Drums: Asbestos-transporting drums, sealable and clearly marked with warning labels as required by OSHA and EPA.

H. Polyethylene Disposal Bags: Asbestos disposal bags, minimum of fire retardant 6-mil thick. Bags shall be clearly marked with warning labels as required by OSHA and EPA.

I. Signs: Asbestos warning signs for posting at perimeter of Work Area, as required by OSHA and EPA.

J. Waste Container Bag Liners and Flexible Trailer Trays: One piece leak-resistant flexible tray with absorbent pad.

K. Tape: Provide tape which is of high quality with an adhesive that is formulated to aggressively stick to sheet polyethylene.

L. Spray Adhesive: Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

M. Flexible Duct: Spiral reinforced flex duct for air filtration devices.

N. Protective Clothing: Workers shall be provided with sufficient sets of properly fitting, full-body, disposable coveralls, head covers, gloves, and 18-inch high boot-type foot covers. Protective clothing shall conform to OSHA Standard 29 CFR 1926.1101.

O. Surfactants, strippers, sealers, or any other chemicals used shall be non-carcinogenic and non-toxic.

P. Materials used in the construction of temporary enclosures shall be noncombustible or fire-retardant in accordance with NFPA 701 and 255.

2.03 TOOLS AND EQUIPMENT

A. Air Filtration Device (AFD): AFDs shall be equipped with High Efficiency Particulate Air (HEPA) filtration systems and shall be approved by and listed with Underwriter's Laboratory.

B. Scaffolding: All scaffolding shall be designed and constructed in accordance with OSHA (29 CFR 1926/1910), New York City Building Code, and any other applicable federal, state and local government regulations. Whenever there is a conflict or overlap of the above references the most stringent provisions are applicable. All scaffolding and components shall be capable of supporting without failure a minimum of four times the maximum intended load, plus an allowance for impact. All scaffolding and staging must be certified in writing by a Professional Engineer licensed to practice in the State of New York.

1. Equip rungs of all metal ladders, etc., with an abrasive, non-slip surface.

2. Provide non-skid surface on all scaffold surfaces subject to foot traffic. Scaffold ends and joints shall be sealed with tape to prevent penetration of asbestos fibers.

C. Transportation Equipment: Transportation Equipment, as required, shall be suitable for loading, temporary storage, transit and unloading of asbestos contaminated waste without exposure to persons or property. Any temporary storage containers positioned outside the building for temporary storage shall be metal, closed and locked.

D. Vacuum Equipment: All vacuum equipment utilized in the Work Area shall utilize HEPA filtration systems.

E. Vacuum Attachments: Soft Brush Attachment, Asbestos Scraper Tool, Drill Dust Control Kit.

F. Electric Sprayer: An electric airless sprayer suitable for application of encapsulating material and shall be approved by and listed with Underwriters Laboratory.

G. Water Sprayer: The water sprayer shall be an airless or other low-pressure sprayer for amended water application.

H. Water Atomizer: Powered air-misting device equipped with a ground fault interrupter and equipped to operate continuously.

I. Brushes: All brushes shall have nylon bristles. Wire brushes are excluded from use due to their potential to shred asbestos fibers into small, fine fibers. Wire brushes maybe used for cleaning pipe joints within glove-bags upon written approval of the Construction Project Manager.

J. Power tools used to drill, cut into, or otherwise disturb ACM shall be manufacturer-equipped with HEPA filtered local exhaust ventilation. Abrasive removal methods, including the use of beadblasters, are prohibited.

K. Other Tools and Equipment: Asbestos abatement contractor shall provide other suitable tools for the stripping, removal, encapsulation, and disposal activities including but not limited to: hand-held scrapers, sponges, rounded-edge shovels, brooms, and carts.

L. Fans and Leaf Blower: Provide Leaf Blower (one leaf blower per floor) and one 20-inch diameter fans for each 10,000 cubic feet of Work Area volume to be used for aggressive sampling technique for clearance air testing.

M. Fire Extinguishers: At least one fire extinguisher with a minimum rating 2-A:10-B:C shall be required for each work place. In the case of large asbestos projects, at least two such fire extinguishers shall be required.

N. First Aid Kits: Asbestos abatement contractor shall maintain adequately stocked first aid kits in the clean rooms of the decontamination units and within Work Areas. The first aid kit shall be approved by a licensed physician for the work to be performed under this Contract.

O. Water Service:

1. Temporary Water Service Connection: All connections to the Facilities water system shall include back flow protection. Valves shall be temperature and pressure rated for operation of the temperature and pressures encountered. After completion of use, connections and fittings shall be removed without damage or alteration to existing water piping, and equipment. Leaking or dripping fittings/valves shall be repaired and or replaced as required.

2. Water Hoses: Employ new heavy-duty abrasion-resistant hoses with a pressure rating greater than the maximum pressure of the water distribution system to provide water into each Work Area and to each Decontamination Enclosure Unit. Provide fittings as required for connection to existing wall hydrants or spouts, as well as temporary water heating equipment, branch piping, showers, shut-off nozzles and equipment.

3. Water Heater: Provide UL rated 40-gallon electric water heaters to supply hot water for Personal Decontamination Enclosure System Shower. Activate from 30 Amp Circuit breakers located within the Decontamination Enclosure sub panel. Provide relief valve compatible with water heater operations, pipe relief valve down to drip pan at floor level with type 'L' copper piping. Drip pans shall be 6-inch deep and securely fastened to water heater. Wiring of the water heater shall comply with NEMA, NECA, and UL standards.

P. Electrical Service:

1. General: Comply with applicable NEMA, NECA and UL standards and governing regulations for materials and layout of temporary electric service.

2. Temporary Power: Provide service to decontamination unit sub panel with minimum 60 AMP, two pole circuit breaker or fused disconnect connected to the building's main distribution panel. Sub panel and disconnect shall be sized and equipped to accommodate all electrical equipment required for completion of the work.

3. Voltage Differences: Provide identification warning signs at power outlets that are other than 110-120 volt power. Provide polarized outlets for plug-in type outlets, to prevent insertion of 110-120 volt plugs into higher voltage outlets. Dry type transformers shall be provided where required to provide voltages necessary for work operations.

4. Ground Fault Protection: Equip all circuits for any purpose entering Work Area with ground fault circuit interrupters (GFCI). Locate the GFCIs outside the Work Area so that all circuits are protected prior to entry to Work Area. Provide circuit breaker type ground fault circuit interrupters (GFCI) equipped with test button and reset switch for all circuits to be used for any purpose in Work Area, decontamination units, exterior, or as otherwise required by NEC, OSHA or other authority.

5. Power Distribution System: Provide circuits of adequate size and proper characteristics for each use. In general run wiring overhead, and rise vertically where wiring will be least subject to damage from operations.

6. Temporary Wiring: In the Work Area shall be type UF non-metallic sheathed cable located overhead and exposed for surveillance. Provide liquid tight enclosures or boxes for all wiring devices. Do not wire temporary lighting with plain, exposed (insulated) electrical conductors.

7. Electrical Power Cords: Use only grounded extension cords; use hard service cords where exposed to traffic and abrasion. Use single lengths of cords only.

8. Temporary Lighting: All lighting within the Work Area shall be liquid and moisture proof and designed for the use intended.

    a. Provide sufficient temporary lighting to ensure proper workmanship everywhere; by combined use of daylight, general lighting, and portable plug-in task lighting.

    b. Provide lighting in the Decontamination Unit as required to supply a minimum 50-foot candle light level.

9. If electrical circuits, machinery, and other electrical systems in or passing though the work area must stay in operation due to health and safety requirements, the following precautions must be taken:

    a. All unprotected cables, except low-voltage (less than 24 volts) communication and control system cables, panel boxes of cables and joints in live conduit that run through the work area shall be covered with three (3) independent layers of six (6) mil fire retardant polyethylene. Each layer shall be individually duct taped and sealed. All three (3) layers of polyethylene sheeting shall be left in place until satisfactory clearance air sampling results have been obtained.

2.04 CLEANING

A. Throughout the construction period, the asbestos abatement contractor shall maintain the building as described in this Section.

1. The asbestos abatement contractor shall prevent building areas other than the Work Area from becoming contaminated with asbestos-containing dust or debris. Should areas outside the Work Area become contaminated with asbestos-containing dust or debris as a consequence of the asbestos abatement contractor's work practices, the asbestos abatement contractor shall be responsible for cleaning these areas in accordance with the procedures appended in Title 15, Chapter 1 of RCNY and NYSDOL ICR56. All costs incurred in cleaning or otherwise decontaminating non-Work Areas and the contents thereof shall be borne by the asbestos abatement contractor at no additional cost to the City.

2. The asbestos abatement contractor shall provide to all personnel and laborers the required equipment and materials needed to maintain the specified standard of cleanliness.

B. General

1. Waste water from asbestos removal operations, including shower water, may be discharged into the public sewer system only after approved filtration is on operation to remove asbestos fibers.

2. Asbestos wastes shall be double bagged in six mil (.006") fire retardant polyethylene bags approved for ACM disposal and shall be properly labeled and handled before disposal.

3. All waste generated shall be bagged, wrapped or containerized immediately upon removal. The personal and waste decontamination enclosure systems and floor and scaffold surfaces shall be HEPA vacuumed and wet cleaned at the end of each work shift at a minimum.

4. The asbestos abatement contractor shall use corrugated cartons or drums for disposal of asbestos-containing waste having sharp edged components (e.g., nails, screws, metal lathe and tin sheeting) that may tear polyethylene bags and sheeting. The waste within the drums or cartons must be double bagged.

5. The asbestos abatement contractor shall transport all bags of waste to disposal site in thirty gallon capacity metal or fiber drums with tight lids, or in locked steel dumpster.

6. Dumping of debris, waste or bagged waste will not be permitted.

7. The waste decontamination enclosure system shall be wet cleaned twice using wet cleaning methods upon completion of waste removal. When the worker decontamination enclosure shower room alternates as a waste container wash room, the shower room shall be washed immediately with cloths or mops saturated with a detergent solution prior to wet cleaning.

8. Excessive water accumulation or flooding in the work area shall require work to stop until the water is collected and disposed of properly.

9. ACM shall be collected utilizing rubber dust pans and rubber squeegees.

10. HEPA vacuums shall not be used on wet materials unless specifically designed for that purpose.

11. Metal shovels shall not be used within the work area.

12. Mastic solvent when used will be applied in moderation (e.g., by airless sprayer). Saturation of the concrete floor with mastic solvent must be avoided.

13. The asbestos abatement contractor shall retain all items in the storage area in an orderly arrangement allowing maximum access, not impeding traffic, and providing the required protection of all materials.

14. The asbestos abatement contractor shall not allow accumulation of scrap, debris, waste material, and other items not required for use in this work. When asbestos contaminated waste must be kept on the work site overnight or longer, it shall be double bagged and stored in accordance with New York City Department of Sanitation (NYCDOS) regulation Title 16 Chapter 8, and Federal, State and City laws.

15. At least twice a week (more if necessary), the asbestos abatement contractor shall completely remove all scrap, debris and waste material from the job site.

16. The asbestos abatement contractor shall provide adequate storage space for all items awaiting removal from the job site, observing all requirements for fire protection and concerns for the environment.

17. All respiratory protection equipment shall be selected from the latest NIOSH Certified Equipment list.

18. Daily and more often, if necessary, the asbestos abatement contractor shall inspect the Work Areas and adjoining spaces, and pick up all scrap, debris, and waste material. All such items shall be removed to the place designated for their storage.

19. Weekly, and more often, if necessary, the asbestos abatement contractor shall inspect all arrangements of materials stored on the site; re-stack and tidy them or otherwise service them to meet the requirements of these Specifications.

20. The asbestos abatement contractor shall maintain the site in a neat and orderly condition at all times.

PART 3 – EXECUTION

3.01 WORKER DECONTAMINATION FACILITY

A. Large Asbestos Projects (Small Project Option):

1. Provide a worker decontamination facility in accordance with, Title 15, Chapter 1, OSHA Standard 29 CFR 1926.1101, 12NYCRR Part 56 and as specified herein. Unless approved by NYCDEP and the City, worker decontamination facilities shall be attached to the Work Areas

a. Structure:

(1) Use modular systems or build using wood or metal frame studs, joists, and rafters placed at a maximum of 16 inches on-center.

(2) When worker decontamination unit is located outdoors, in areas with public access, or in correctional facilities, frame work shall be lined with minimum 3/8" thickness fire rated plywood sheathing. Sheathing shall be caulked or taped airtight at all joints and seams.

(3) Interior shall be covered with two layers of fire retardant 6-mil polyethylene sheeting, with a minimum overlap of 12 inches at seams. Seal seams airtight using tape and adhesive. The interior floor shall be covered with two (2) layers of reinforced fire-retardant polyethylene sheeting with a minimum overlap on the walls of twelve inches.

(4) Entrances to the decontamination unit shall be secured with lockable hinged doors. Doors shall be open at all times when abatement operations are in progress. Doors shall be louvered to allow for air movement through the decontamination units into Work Area.

b. Curtained Doorways: A device to allow ingress or egress from one room to another while permitting minimal air movement between the rooms.

c. Air Locks: Air locks shall consist of two curtained doorways placed a minimum of three feet apart.

d. Decontamination Enclosure System shall be placed adjacent to the Work Area and shall consist of three totally enclosed chambers, separated from Work Area and each other by airlocks, as follows:

(1) Equipment Room: The equipment room shall have a curtain doorway to separate it from the Work Area, and share a common airlock with the shower room. The equipment room shall be large enough to accommodate at least one worker (allowing them enough room to remove their protective clothing and footwear), and a fire retardant 6-mil disposal bag for collection of discarded clothing and equipment. The equipment room shall be utilized for the storage of equipment and tools after decontamination using a HEPA-vacuum and/or wet cleaning. A one-day supply of replacement filters, in sealed containers, for HEPA-vacuums and negative air machines, extra tools, containers of surfactant, and other materials and equipment required for the project shall be stored here. A walk-off pan filled with water shall be placed in the Work Area just outside the equipment room for persons to clean foot coverings when leaving the Work Area. Contaminated footwear and reusable work clothing shall be stored in this room.

(2) Shower Room: The shower room shall have two airlocks (one that separates it from the equipment room and one that separates it from the clean room). The shower room shall contain at least one shower, with hot and cold water adjustable at the tap, per six workers. Careful attention shall be given to the shower to ensure against leaking of any kind and shall contain a rigid catch basin at least six inches deep. Asbestos abatement contractor shall supply towels, shampoo and liquid soap in the shower room at all times. Shower water shall be continuously drained, collected, and filtered through a system with at least a 5-micron particle size collection capacity. A system containing a series of several filters with progressively smaller pore sizes shall be used to avoid rapid clogging of the filters by large particles. Pumps shall be installed, maintained and utilized in accordance with manufacturer's recommendations. Filtered water shall be discharged in accordance with applicable codes. Contaminated filters shall be disposed of as asbestos waste.

(3) Clean Room: The clean room shall share a common airlock with the shower room and shall have a curtained doorway to separate it from outside non-contaminated areas. Lockers, for storage of workers' street clothing, and shelves, for storing respirators, shall be provided in this area. Clean disposable clothing, replacement filters for respirators, and clean dry towels shall be provided in the clean room. The clean room shall not be used for the storage of tool, equipment or other materials.

B. Small Asbestos Projects:

1. Provide a worker decontamination facility in accordance with, Title 15, Chapter 1, OSHA Standard 29 CFR 1926.1101, 12NYCRR Part 56 and as specified herein. Unless approved by NYCDEP and the City, worker decontamination facilities shall be attached to the Work Areas.

2. The worker decontamination enclosure system shall consist of, as a minimum, an equipment room, a shower room, and a clean room separated from each other and from the work area by curtained doorways. The equipment storage, personnel gross decontamination and removal of disposal clothing shall occur in the equipment room prior to entering the shower. All other requirements shall be the same as described above for a large asbestos project.

3. For small asbestos projects with only one exit from the work area, the shower room may be used as a waste washroom. The clean room shall not be used for waste storage. All other requirements shall be the same as described above for a large asbestos project.

C. Decontamination Enclosure System Utilities: Lighting, heat, and electricity shall be provided as necessary by the Asbestos abatement contractor, and as specified herein.

3.02 WASTE DECONTAMINATION FACILITY

A. Large Asbestos Project (Small Project Option)

1. Provide a worker decontamination facility in accordance with, Title 15, Chapter 1, OSHA Standard 29 CFR 1926.1101, 12NYCRR Part 56 and as specified herein. Unless approved by NYCDEP and the City, worker decontamination facilities shall be attached to the Work Areas.

a. Structure:

(1) Use modular systems or build using wood or metal frame studs, joists, and rafters placed at a maximum of 16 inches on-center.

(2) When worker decontamination unit is located outdoors, in areas with public access, or in correctional facilities, frame work shall be lined with minimum 3/8" thickness fire rated plywood sheathing. Sheathing shall be caulked or taped airtight at all joints and seams.

(3) Interior walls shall be covered with two layers of fire retardant 6-mil polyethylene sheeting, with a minimum overlap of 12 inches at seams. Seal seams airtight using tape and adhesive. The interior floor shall be covered with two (2) layers of reinforced fire-retardant polyethylene sheeting with a minimum overlap on the walls of twelve inches.

(4) Entrances to the decontamination unit shall be secured with lockable hinged doors. Doors shall be open at all times when abatement operations are in progress. Doors shall be louvered to allow for air movement through the decontamination units into the Work Area.

b. Curtained Doorways: A device to allow ingress or egress from one room to another while permitting minimal air movement between the rooms.

c. Air Locks: Air locks shall consist of two curtained doorways placed a minimum of three feet apart.

d. Decontamination Enclosure System shall be located outside the work area and attached to all locations through which ACM waste will be removed from the work area and shall consist of two totally enclosed chambers, separated from the Work Area and each other by airlocks, as follows:

(1) Washroom: An equipment washroom shall have two air locks (one separating the unit from the Work Area and one common air lock that separates it from the holding area). The washroom shall have facilities for washing material containers and equipment. Gross removal of dust and debris from contaminated material containers and equipment shall be accomplished in the Work Area, prior to moving to the washroom.

(2) Holding Area: A holding area shall share a common air lock with the equipment washroom and shall have a curtained doorway to outside areas. A hinged, lockable door shall be placed at the holding area entrance to prevent unauthorized access into the Work Area.

B. Small Asbestos Project:

1. The worker decontamination enclosure system shall consist of, as a minimum, an equipment room, a shower room, and a clean room separated from each other and from the work area by curtained doorways. The equipment storage, personnel gross decontamination and removal of disposal clothing shall occur in the equipment room prior to entering the shower. All other requirements shall be the same as described above for a large asbestos project.

2. For small asbestos projects with only one exit from the work area, the shower room may be used as a waste washroom. The clean room shall not be used for waste storage. All other requirements shall be the same as described above for a large asbestos project.

C. Decontamination Enclosure System Utilities: Lighting, heat, and electricity shall be provided as necessary by the Asbestos abatement contractor, and as specified herein.

3.03 PERSONNEL ENTRANCE AND DECONTAMINATION PROCEDURES FOR REMOVAL OPERATIONS UTILIZING REMOTE DECONTAMINATION FACILITIES

A. All individuals who enter the Work Area shall sign the entry log, located in the clean room, upon each entry and exit. The log shall be permanently bound and shall fully identify the facility, agents, asbestos abatement contractor(s), the project, each Work Area, and worker respiratory protection employed. The job supervisor shall be responsible for the maintenance of the log during the abatement activity. The log shall be submitted to the NYC DDC within 48 hours of request.

B. Each worker shall remove street clothes in the clean room; wear two disposable suits, including gloves, hoods and non-skid footwear; and put on a clean respirator (with new filters) before entering the Work Area.

C. Each worker shall, before leaving the Work Area or tent, clean the outside of the respirators and outer layer of protective clothing by wet cleaning and/or HEPA-vacuuming. The outer disposable suit shall be removed in the airlock prior to proceeding to the Worker Decontamination Unit. The inner disposable suit and respirator shall be wet wiped and HEPA vacuumed thoroughly before removing and prior to aggressive shower.

D. Following showering and drying off, each worker or authorized visitor shall proceed directly to the clean room, dress in street clothes, and exit the decontamination enclosure system immediately.

3.04 PERSONNEL ENTRANCE AND DECONTAMINATION PROCEDURES FOR REMOVAL OPERATIONS UTILIZING ATTACHED DECONTAMINATION FACILITIES

A. All workers and authorized visitors shall enter the Work Area through the worker decontamination facility.

B. All individuals who enter the Work Area shall sign the entry log, located in the clean room, upon each entry and exit. The log shall be permanently bound and shall identify fully the facility, agents, asbestos abatement contractor(s), the project, each Work Area and worker respiratory protection employed. The site supervisor shall be responsible for the maintenance of the log during the abatement activity. The log shall be submitted to the NYC DDC within 48 hours of request.

C. Each worker or authorized visitor shall, upon entering the job site, remove street clothes in the clean room and put on a clean respirator with filters, and clean protective clothing before entering the Work Area through the shower room and equipment room.

D. Each worker or authorized visitor shall, each time he leaves the Work Area, remove gross contamination from clothing before leaving the Work Area; proceed to the equipment room and remove clothing except the respirator; still wearing the respirator, proceed to the shower room; clean the outside of the respirator with soap and water while showering; remove filters, wet them, and dispose of them in the container provided for that purpose; wash and rinse the inside of the respirator; and thoroughly shampoo and wash himself/herself.

E. Following showering and drying off, each worker or authorized visitor shall proceed directly to the clean room, dress in street clothes, and exit the decontamination enclosure system immediately. Disposable clothing of the type worn inside the Work Area is not permitted outside the Work Area.

3.05 MAINTENANCE OF DECONTAMINATION ENCLOSURE FACILITIES AND BARRIERS

The following procedures shall be followed during abatement activities.

A. All polyethylene barriers inside the work place and partitions constructed to isolate the Work Area from occupied areas shall be inspected by the asbestos handler supervisor at least twice per shift.

B. Smoke tubes shall be used to test the integrity of the Work Area barriers and the decontamination enclosure systems daily before abatement activity begins and at the end of each shift.

C. Damage and defects in the decontamination enclosure system shall be repaired immediately upon discovery. The decontamination enclosure system shall be maintained in a clean and sanitary condition at all times.

D. At any time during the abatement activity, if visible emissions are observed, or elevated asbestos fiber counts outside the Work Area are measured, or if damage occurs to barriers, abatement shall stop. The source of the contamination shall be located, the integrity of the barriers shall be restored and extended to include the contaminated area, and visible residue shall be cleaned up using appropriate HEPA-vacuuming and wet cleaning.

E. Inspections and observations shall be documented in the daily project log by the asbestos handler supervisor.

F. The daily inspection to ensure that exits have been checked against exterior blockage or impediments to exiting shall be documented in the log book. If exits are found to be blocked, abatement activities shall stop until the blockage is cleared.

3.06 MODIFICATIONS TO HVAC SYSTEMS

A. Shut down, isolate or seal, all existing HVAC units, fans, exhaust fans, perimeter convection air units, supply and/or return air ducts, etc., situated in, traversing or servicing the work zone.

B. Seal all seams with duct tap. Wrap entire duct with a minimum of two layers of fire retardant 6-mil polyethylene sheeting. All shutdowns are to be coordinated with the Facility. Where systems must be maintained, i.e., traversing Work Areas to non-Work Areas, only supply ducts will be maintained, protect as described above. All returns must be blanked off in Work Area and adjacent areas, including floor above and below Work Area. When required Asbestos abatement contractor shall apply for a clarification from NYCDEP. The Asbestos abatement contractor shall implement the following engineering procedures:

1. Maintenance of a positive pressure within the HVAC system of 0.01 inch water gauge (or greater) with respect to the ambient pressure outside the Work Area. The conditions for this system shall be maintained and be operational 24 hours per day from the initiation of Work Area preparation until successful final air clearance. Positive pressurization of HVAC system shall be applied only under the direction and control of professional engineer, or other knowledgeable licensed professional;

2. The positive pressurization of the duct shall be tested, inspected and recorded both at the beginning and at the end of each shift;

3. The positive pressurization shall be monitored using instrumentation which will provide a written record of pressurization and that will trigger an audible alarm, if the static pressure falls below the set value;

4. The supply air fan and the supply air damper for the active positive-pressurized duct shall be placed in the manual "on" positions to prevent shutdown by fail-safe mechanisms;

5. The return air fan and the return air dampers shall be shut down and locked-out;

6. All the seams of the HVAC ducts that pass through the Work Area shall be sealed;

7. The HVAC ducts that pass through the Work Area shall be covered with two (2) layers of fire retardant 6-mil polyethylene sheeting, and all seams and edges of both layers shall be sealed airtight;

8. The supply air fans, return air fans, and all dampers servicing the Work Area itself shall be shut down and locked-out. All openings within the Work Area of supply and return air ducts shall be sealed with 3/8-inch fire rated plywood and two layers of fire retardant 6-mil polyethylene;

9. When abatement occurs during periods while the HVAC system is shut down an alternative method of pressurization of the duct passing through the Work Area should be employed (e.g., by low-pressure "blowers", etc., directly coupled into the duct). Item #4 above shall be deleted and shall be replaced by the requirement to set the dampers of the HVAC duct in the manual closed positions, in order to effect pressurization.

C. Asbestos abatement contractor to coordinate this item with the Facility and Construction Project Manager at the commencement of work. Where present HVAC systems (ducts) service an area and that air system cannot be shut down, asbestos abatement contractor shall isolate and seal the ducts, both supply and return, at the boundary of that zone.

1. To isolate, cap, or seal a duct, the asbestos abatement contractor shall remove insulation from duct (if necessary), then disconnect linkage to fold shut all fire dampers. Asbestos abatement contractor shall seal all edges and seams with caulk and duct-tape.

2. Asbestos abatement contractor shall then cut existing duct and fold metal in and secure with approved fasteners. Asbestos abatement contractor shall caulk and duct-tape all seams and edges.

3. All ducts shall then be completely wrapped and sealed with duct-tape and three (3) layers of reinforced polyethylene sheeting.

4. All ducts shall be restored to original working order at the end of the project.

D. Where present HVAC systems (ducts) service occupied areas (non-Work Areas), the Asbestos abatement contractor shall blank off the ducts.

1. To isolate or seal the return duct, the asbestos abatement contractor shall remove any insulation (if necessary) from the duct. Then disconnect linkage to fold shut all fire dampers and insert a fiberglass board within the duct. Asbestos abatement contractor shall seal all edges and seams with caulk, duct-tape and three (3) layers of reinforced polyethylene sheeting.

2. All isolation of return ducts and any other activity that requires removal of ceiling by the asbestos abatement contractor shall be conducted under controls. Work is to be coordinated with the Construction Project Manager and the Facility and is described as follows:

a. Work shall occur as scheduled.

b. Horizontal surfaces near the blanking operations shall be protected with fire retardant 6-mil polyethylene sheeting.

c. Plastic drapes shall be used to enclose the immediate area.

d. Asbestos abatement contractor to position and operate air filtration devices and HEPA-vacuums in the area to clean space after blanking operations.

e. All personnel involved with this work shall receive personal protection (i.e., respirators and disposable suits).

E. Upon loss of negative pressure or electric power, all work activities in an area shall cease immediately and shall not resume until negative pressure and/or electric power has been fully restored. When a power failure or loss of negative pressure lasts, or is expected to last, longer than thirty (30) minutes, the following sequence of events shall occur.

1. All make up air inlets shall be sealed airtight.

2. All decontamination facilities shall be sealed airtight after evacuation of all personnel from the Work Area.

3. All adjacent areas shall be monitored for potential fiber release upon discovery of and subsequently throughout, power failure.

3.07 LOCKOUT OF HVAC SYSTEMS, ELECTRIC POWER, AND ACTIVE BOILERS

Prior to the start of any prep work, the asbestos abatement contractor shall employ skilled tradesmen with limited asbestos licenses for the following work:

A. Disable all ventilating systems or other systems bringing air into or exhausting air out of the Work Area. Disable system by disconnecting wires removing circuit breakers, by lockable switch or other positive means to ensure against accidental re-starting of equipment.

B. Lock out power to the Work Area by switching off all breakers and removing them from panels or by switching and locking entire panel. Label panel with following notation: "DANGER CIRCUIT BEING WORKED ON". Give all keys to Facility.

C. Lock out power to circuits running through Work Area whenever possible by switching off and removing breakers from panel. If circuits must remain live, the Facility shall notify asbestos abatement contractor in order that he may secure a variance from NYCDEP. The asbestos abatement contractor shall protect all conduit and wires to remain and label all active circuits at intervals not to exceed 3 feet with tags having the following notation: "DANGER LIVE ELECTROCUTION HAZARD". The asbestos abatement contractor shall label all circuits in all locations including hidden locations that may be affected by the work in a similar manner.

D. All boilers and other equipment within the work area shall be shut down, locked out, tagged out and the burner/boiler/equipment accesses and openings shall be sealed until abatement activities are complete. If the boiler or other exhausted equipment will be subject to abatement, all breeching, stacks, columns, flues, shafts, and double-walled enclosures serving as exhausts or vents shall be segregated from the affected boiler or equipment and sealed airtight to eliminate potential chimney effects within the work area.

PART 4 – PREPARATION OF WORK AREA AND REMOVAL PROCEDURES

4.01 REMOVAL OF ASBESTOS-CONTAINING MATERIAL

A. Asbestos abatement contractor Responsibility

Asbestos abatement contractor shall be responsible for the proper removal of ACM from the Work Area using standard industry techniques. The Third-Party Air Monitor representative shall observe the Work.

1. General Requirements:

   a. Removal of ACM shall be performed using wet methods. Dry removal of ACM is prohibited.

   b. Spray ACM with amended water with sufficient frequency and quantity to enhance penetration. Sufficient time shall be allowed for amended water to penetrate the material to the substrate prior to removal. All ACM shall be thoroughly wetted while work is being conducted.

   c. Accumulation of standing water on the floor of the Work Area is prohibited.

   d. Apply removal encapsulants, when used, in accordance with the manufacturer's recommendations and guidelines.

   e. Containerize ACM immediately upon detachment from the substrate. Alternately, ACM may be dropped in to a flexible catch basin and promptly bagged. Detached ACM is not permitted to lie on the floor for any period of time. Excess air within the bag shall be removed before sealing. ACM shall not be dropped from a height of greater than 10 feet. Above 10 feet, dust free inclined chutes may be used. Maximum inclination from horizontal shall be 60-degrees for all chutes.

   f. Exits from the work area shall be maintained, or alternative exits shall be established, in accordance with section 1027 of the New York City Fire Code. Exits shall be checked at the beginning and end of each work shift against blockage or impediments to exiting.

   g. Signs clearly indicating the direction of exits shall be maintained and prominently displayed within the work area.

   h. No smoking signs shall be maintained and prominently displayed within the work place.

   i. At least one fire extinguisher with a minimum rating 2-A:10-B:C shall be required for each work place. In the case of large asbestos projects, at least two such fire extinguishers shall be required.

   j. If the containment area of an asbestos project covers the entire floor of the affected building, or an area greater than 15,000 square feet on any given floor, the installation of a negative air cut off switch or switches shall be required at a single location outside the work place, such as inside a stairwell, or at a secured location in the ground floor lobby when conditions warrant. The required switch or switches shall

be installed by a licensed electrician pursuant to a permit issued by the Department of Buildings. If negative pressure ventilation equipment is used on multiple floors the cut off switch shall be able to turn off the equipment on all floors.

B. Removal of ACM Utilizing Full Containment Procedures shall be as follows:

1. Preparation Procedures:

a. Ensure that the Third-Party Air Monitor has performed area monitoring and established a background count prior to the preparatory operations for each removal area, as applicable.

b. Shut down, isolate, and lock out or tag heating, ventilating, and air conditioning (HVAC) systems which serve or which pass through the Work Area. Vents within the Work Area and seams in HVAC components shall be sealed with tape and two layers of fire retardant polyethylene sheeting. Filters in HVAC systems shall be removed and treated as asbestos-asbestos contaminated waste.

c. Shut down, disconnect, and lock out or tag all electric power to the Work Area so that there is no possibility of its reactivation until after clearance testing of the Work Area.

d. Provide and install decontamination enclosure systems in accordance with Sections 3.01 and 3.02 of this Section.

e. Remove ACM that may be disturbed by the erection of partitions using tent procedures and wet removal methods. Removal shall be limited to a one-foot wide strip running the length/height of the partition.

f. Pre-clean and remove moveable objects from the Work Area. Pre-cleaning shall be accomplished using HEPA-vacuum and wet-cleaning techniques. Store moveable objects at a location determined by the City.

g. Protect carpeting that will remain in the Work Area.

(1) Pre-clean carpeting utilizing wet-cleaning techniques.

(2) Install a minimum of two layers of fire retardant 6-mil reinforced polyethylene sheeting over carpeting.

(3) Place a rigid flooring material, minimum thickness of 3/8-inch, over polyethylene sheeting.

h. Pre-clean all fixed objects to remain within the Work Area using HEPA-vacuum and wet-cleaning techniques.

i. Seal fixed objects with two individual layers, minimum, of 6-mil fire retardant polyethylene sheeting.

j. Pre-clean entire Work Area utilizing HEPA-vacuum and wet-cleaning techniques. Methods of cleaning that raise dust; such as dry sweeping or use of vacuum equipment not equipped with HEPA-filters, is prohibited.

k. Install isolation barriers (i.e., sealing of all openings, including but not limited to windows, corridors, doorways, skylights, ducts, grills, diffusers, and other penetrations within the Work Area) using two layers of 6-mil fire retardant polyethylene sheeting and duct-tape.

l. Construct rigid framework to support Work Area barriers.

(1) Framework shall be constructed using 2-inch by 4-inch wooden or metal studs placed 16 inch on center when existing walls and/or ceiling do not exist for all openings greater than 32 square feet. Framework is not required except where one dimension is one foot or less or the opening will be used as an emergency exit.

(2) Apply a solid construction material, minimum thickness of 3/8-inch to the Work Area side of the framing. In secure interior areas, not subject to access from the public or building occupants, an additional layer of 6-mil fire retardant polyethylene sheeting may be substituted for the rigid construction material.

(3) Caulk all wall, floor, ceiling, and fixture joints to form a leak tight seal.

m. Seal floor drains, sumps, shower tubs, and other collection devices with two layers of 6-mil fire retardant plastic and fire rated plywood, as necessary, and provide a system to collect all water used by the asbestos abatement contractor. Collected water shall be passed through a water filtration system prior to being discharged into the sanitary sewer.

n. Remove ceiling mounted objects not previously sealed that will interfere with removal operations. Mist object and surrounding ACM with amended water prior to removal to minimize fiber dispersal. Clean all moveable objects using HEPA-vacuum and wet-cleaning techniques prior to removal from the Work Area.

o. Fiberglass insulation with intact coverings shall be protected in place during abatement activities. These materials shall be protected with two layers of 6-mil fire retardant polyethylene sheeting as isolation barriers and two additional layers of 6-mil fire retardant polyethylene sheeting serving as primary and secondary surface barriers.

p. Install and initiate operation of AFDs to provide a negative pressure and a minimum of four air changes per hour within the Work Area relative to surrounding non-Work Areas. Do not shut down AFDs until the Work Area is released to the City following final clearance procedures. The use of HEPA-filtered vacuum to produce a negative air pressure inside the enclosure is prohibited.

q. Maintain emergency and fire exits from the Work Areas or establish alternative exits satisfactory to the local fire officials. Emergency exits and routes shall be established and clearly marked with florescent paint or other effective designations to permit easy location from anywhere within the Work Area. Cutting tools (e.g., knife, razor) shall be attached to the work area side of the sheeting for use in the event that the barrier must be cut open to allow egress. Emergency exits shall be secured to prevent access from uncontaminated areas and yet permit emergency exiting. Exits shall be checked daily against exterior blockage or impediments to exiting.

r. Temporary lighting within the Work Area and decontamination system shall be provided as required to achieve minimum illumination levels.

s. Hand power tools used to drill, cut into, or otherwise disturb ACM shall be manufacturer-equipped with HEPA filtered local exhaust ventilation.

t. Prior to being plasticized, the Work Areas shall be cleaned using HEPA vacuum equipment and/or wet cleaning methods as appropriate. Methods that raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, shall not be used.

u. Plasticize the area after pre-cleaning, using the following procedures.

(1) Cover floors with one layer of 6-mil fire retardant polyethylene sheeting, turning layer a minimum of 6 inches up wall, and seal layer to wall.

(2) Cover walls with one layer of 6-mil fire retardant polyethylene sheeting, overlapping wall layer a minimum of 6 inches, and seal layer to floor layer.

(3) Cover floors with a second layer of 6-mil fire retardant polyethylene sheeting, turning layer a minimum of 12 inches up wall, and seal layer to wall.

(4) Cover walls with a second layer of fire retardant 6-mil polyethylene sheeting, overlapping wall layer a minimum of 12 inches, and seal layer to floor layer.

(5) In areas where demolition is required to access ACM, a layer of fire retardant 6-mil reinforced polyethylene sheeting shall be placed on the floor of the enclosure.

(6) Perform demolition required to access ACM. Debris resulting from demolition activities shall be disposed of as ACM waste as described in this Specification.

(7) Repeat preparation of areas accessed by demolition activities as described above.

v. Suspended ceiling tiles and T-grid components shall remain in place until the preparation of the Work Area below the ceiling tiles are completed and personnel and equipment decontamination enclosures have been constructed.

w. Scaffolds shall be provided for workers engaged in work that cannot safely be performed from the ground or other solid Work Area surface.

x. Means of egress shall not be obstructed by hardwall barriers.

y. Pre-Removal Inspections.

(1) Prior to removal of any ACM, the asbestos abatement contractor shall notify the Third-Party Air Monitor and request a pre-removal inspection. Posting of warning signs, building of decontamination enclosure systems, and all other preparatory steps have been taken prior to notification of the Third-Party Air Monitor.

(2) Asbestos abatement contractor shall correct any deficiencies observed by Third-Party Air Monitor at no additional cost to City.

(3) Following the Third-Party Air Monitor's approval of the Work Area preparations, removal of ACM may commence.

2. Removal of ACM Within Full Containment:

a. Mist material with amended water. Allow sufficient time for the amended water to penetrate the material to be removed.

b. Remove the material using hand tools such as scrapers or putty knives. Wire-mesh or wood lathe reinforcing, when present, shall be cut into manageable pieces and disposed of as ACM.

c. Remove any residual material from the substrate using wet cleaning methods and nylon-bristled hand brushes.

d. Place the removal material immediately into a properly labeled fire retardant 6-mil polyethylene bag. All material shall be properly containerized and decontaminated prior to removal from the Work Area.

e. Following the completion of removal of insulation, all visible residue shall be removed from the substrate.

3. Following Removal of ACM utilizing Full Containment Procedures:

a. First Cleaning:

(1) Remove any visible accumulation of asbestos material and debris. HEPA-vacuuming and wet cleaning shall be performed on all surfaces inside the Work Area. All sealed drums, plastic bags, and equipment used in the Work Area shall be removed from the Work Area.

(2) Upon request of the asbestos abatement contractor, the Third-Party Air Monitor will perform a visual inspection. Evidence of asbestos contamination identified during the inspection will necessitate further cleaning as heretofore specified.

(3) Remove first layer of plastic sheathing inside the Work Area. The isolation barriers and decontamination facility shall remain in place and be utilized.

b. Second Cleaning:

(1) After the first cleaning, the Work Area shall be vacated for twelve hours to allow fibers to settle.

(2) All objects and surfaces in the Work Area shall be HEPA - vacuumed and wet cleaned for a second cleaning.

(3) A thin coat of lockdown encapsulant shall be applied to all plastic covered surfaces in the Work Area.

(4) When the encapsulant is dry, second layer of polyethylene sheeting on the walls, ceiling and floors shall be removed. Do not remove seals from doors, windows, Isolation Barriers or disconnect the negative pressure equipment.

c. Third Cleaning:

(1) A minimum of four hours after the second cleaning, all the surfaces in the Work Area shall be HEPA-vacuumed and wet cleaned for a third cleaning.

(2) Upon the request of the asbestos abatement contractor, the Third-Party Air Monitor will do final visual inspection for re-occupancy. Evidence of asbestos contamination identified during the inspection will necessitate further cleaning as heretofore specified.

(3) When the Work Area passes the Third-Party Air Monitor's visual re-occupancy inspection, air sampling shall not begin until at least one hour after the completion of the third cleaning. The Third-Party Air Monitor shall perform air monitoring using aggressive testing techniques. The Third-Party Air Monitor will approve re-occupancy if the specified fiber count in the Work Area is achieved according to the Third-Party Air Monitor.

(4) When the Work Area passes the re-occupancy test, all controls and seals established shall be removed.

(5) The cleaned layer of the surface barriers shall be removed from walls and floors.

(6) The isolation barriers shall remain in place throughout cleanup. Decontamination enclosure systems shall remain in place and be utilized. A thin coat of lockdown encapsulant shall be applied to all surfaces in the work area which were not the subject of removal or abatement, including the cleaned layer of the surface barriers, but excepting sprinklers, standpipes, and other active elements of the fire suppression system.

d. Final Barrier Removal:

(1) Upon receipt of acceptable clearance testing results, polyethylene sheeting and Isolation Barriers shall be removed and disposed accordingly as asbestos-containing material.

(2) The area surrounding the abatement work place shall be cleaned of any visible debris utilizing HEPA vacuum and wet methods.

e. The Third-Party Air Monitor will conduct a final visual observation. Approval must be granted prior to break down of decontamination facility and asbestos abatement contractor demobilization.

C. Removal of ACM utilizing NYCDEP Title 15, Chapter 1 §1-105 Tent and Glove-bag Procedures shall be as follows:

1. Preparation Procedures:

a. Ensure that the Third-Party Air Monitor has performed area monitoring and established a background count prior to the preparatory operations for each removal area, as applicable.

b. Shut down, isolate, and lock out or tag heating, ventilating, and air conditioning (HVAC) systems which serve or which pass through the Work Area. Vents within the Work Area and seams in HVAC components shall be sealed with tape and two layers of polyethylene sheeting. Filters in HVAC systems shall be removed and treated as asbestos-asbestos contaminated waste.

c. Shut down, disconnect, and lock out or tag all electric power to the Work Area so that there is no possibility of its reactivation until after clearance testing of the Work Area.

d. Provide and install decontamination enclosure systems in accordance with PART 3 - EXECUTION, Sections 3.01 and 3.02 of these Specifications. Decontamination facilities may be remote from the Work Areas.

e. Construct rigid framework to support Work Area barriers. Framework shall be constructed using 2-inch by 4-inch wooden or metal studs placed 16 inch on center when existing walls and/or ceiling do not exist.

f. Seal floor drains, sumps, shower tubs, and other collection devices with two layers of fire retardant 6-mil plastic and minimum 3/8" fire rated plywood, as necessary, and provide a system to collect all water used by the asbestos abatement contractor. Collected water shall be passed through a water filtration system prior to being discharged into the sanitary sewer. Any opening greater than 32 square feet shall be framed with 2-inch by 4-inch studding placed 16 inches on center.

g. Install and initiate operation of AFDs to provide a negative pressure and a minimum of four air changes per hour and negative pressure of -0.02" of water column within the Work Area relative to surrounding non-Work Areas. Do not shut down AFDs until the Work Area is released to the City following final clearance procedures. The use of HEPA-filtered vacuums to produce a negative air pressure inside the enclosure is prohibited.

h. Maintain emergency and fire exits from the Work Areas or establish alternative exits satisfactory to the local fire officials. Emergency exits and routes shall be established and clearly marked with florescent paint or other effective designations to permit easy location from anywhere within the Work Area. Emergency exits shall be secured to prevent access from uncontaminated areas and yet permit emergency exiting. Exits shall be checked daily against exterior blockage or impediments to exiting.

i. Temporary lighting within the Work Area and decontamination system shall be provided as required to achieve minimum illumination levels.

j. Hand power tools used to drill, cut into, or otherwise disturb ACM shall be manufacture equipped with HEPA filtered local exhaust ventilation.

k. Prior to being plasticized, the Work Areas shall be cleaned using HEPA-vacuum equipment and/or wet cleaning methods as appropriate. Methods that raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, shall not be used.

l. There shall be an airlock at the entrance to the tent, unless there is an attached worker or waste decontamination system.

m. Plasticize the area after pre-cleaning, using the following procedures. Do not apply polyethylene sheeting to the wall and ceiling surfaces that will be demolished to access ACM.

(1) Cover floor with one layer of fire retardant 6-mil polyethylene sheeting, turning layer a minimum of 12 inches up wall, and seal layer to wall.

(2) Cover walls with one layer of fire retardant 6-mil polyethylene sheeting, overlapping wall layer a minimum of 12 inches, and seal layer to floor layer.

(3) Cover ceilings with one layer of fire retardant 6-mil polyethylene sheeting, overlapping wall layer a minimum of 12 inches, and seal layer to wall layer.

(4) Repeat procedure for second layer. All joints in polyethylene sheeting shall be glued and taped in such a manner as to prohibit air passage. Joints on plastic layers shall be staggered to reduce the potential for water to penetrate.

(5) In areas where demolition is required to access ACM, a layer of fire retardant 6-mil reinforced polyethylene sheeting shall be placed on the floor of the enclosure.

(6) Perform demolition required to access ACM. Debris resulting from demolition activities shall be disposed of as ACM as described in this Specification.

(7) Repeat preparation of areas accessed by demolition activities as described above.

(8) Suspended ceiling tiles and T-grid components shall remain in place until the preparation of the Work Area below the ceiling tiles are completed and personnel and equipment decontamination enclosures have been constructed.

(9) Protect non-ACM insulation within the Work Area(s) with two individual layers of fire retardant 6-mil polyethylene sheeting. Sheeting shall remain in-place until satisfactory clearance air monitoring results are achieved.

n. Installation of glove-bags for removal of thermal system insulation, when required:

(1) General: Glove-bag operations shall be performed using commercially available glove-bags of at least fire retardant 6-mil, transparent plastic appropriately sized for the diameter of the material to be removed. The use of "moveable" glove-bag techniques is strictly forbidden. At no time, shall the glove-bag be sized to allow for the removal of more that three linear feet

of insulation. Glovebag procedures may only be used in conjunction with full containment of the work area or the tent procedure.

(2) Place the necessary tools and materials inside of the tool pouch of the glove-bag before the glove-bag procedure begins.

(3) Place duct-tape securely around the affected area to form a smooth area to which the glove-bag can be securely fastened.

(4) Attach glove-bag to the cable, wire or pipe. Seal top of glove-bag by double folding and stapling. Place duct-tape along the seam to form an airtight seal. Seal sides of glove-bag, where cable, wire or pipe passes through, with duct-tape to form an airtight seal.

(5) If the material adjacent to the work section is damaged, terminates, is jointed or contains an irregularity, wrap the section in two layers of 6-mil fire retardant polyethylene sheeting and seal airtight with duct-tape.

(6) Smoke test each glove-bag as indicated below. The Third-Party Air Monitor shall be present during all smoke testing.

(7) The glovebag shall be placed under negative pressure utilizing a HEPA vacuum, and a smoke tube shall then be aspirated to direct smoke at all seams and seals from outside the glovebag. Any leaks detected by the smoke test shall be duct taped airtight.

(8) All necessary tools and materials shall be brought into the work area before the glovebag procedure begins.

(9) Glovebag procedures shall be conducted by workers specifically trained in glovebag procedures and equipped with appropriate personal protective equipment.

(10) The insulation diameter worked shall not exceed one half the bag working length above the attached gloves.

o. Glovebag procedures shall be conducted by workers specifically trained in glovebag procedures and equipped with appropriate personal protective equipment.

p. Pre-Removal Inspections

(1) Prior to removal of any ACM, the Asbestos abatement contractor shall notify the Third-Party Air Monitor and request a pre-removal inspection. Posting of warning signs, building of decontamination enclosure systems, and all other preparatory steps have been taken prior to notification of the Third-Party Air Monitor.

(2) Asbestos abatement contractor shall correct any deficiencies observed by Third-Party Air Monitor at no additional cost to City.

(3) Following the Third-Party Air Monitor's approval of the Work Area preparations, removal of ACM may commence.

2. Removal of ACM Thermal Insulation Using Glove-Bag Techniques:

a. Mist material with amended water. Allow sufficient time for the amended water to penetrate the material to be removed.

b. Remove the insulation using hand tools such as knives or scissors.

c. Exercise caution when removing insulation.

d. Remove any residual asbestos-containing insulation from the substrate using wet cleaning methods and nylon-bristled hand brushes.

(1) Any insulation ends created by this procedure shall be sealed with encapsulant prior to bag removal or thoroughly wetted before bag removal and sealed with wettable cloth end caps and spray glue or any combination of these materials immediately following bag removal.

(2) The tool pouch shall be separated from the bag prior to disposal by twisting it and the wall to which it is attached several times, and taping the twist to hold it in place, thus sealing the bag and the pouch which are severed at the midpoint of the twist. Alternatively, the tools can be pulled through with one or both glove inserts, thus turning the gloves inside out. The glove(s) is/are then twist sealed forming a new pouch, taped and several mid-seal forming two separate bags.

(3) A HEPA vacuum shall be used for evacuation of the glovebag in preparation for removal of the bag from the surface for clean-up in the event of a spill, and for post project clean-up.

(4) With the glovebag collapsed and the ACM in the bottom of the bag, the bag shall be twisted several times and taped to seal that section during bag removal.

(5) A 6-mil plastic bag shall be slipped around the glovebag while it is still attached to the surface. The bag shall be detached from the surface by removing the tape or cutting the top with blunt scissors.

(6) The asbestos-containing waste, the clean-up materials, and protective clothing shall be wetted sufficiently, double-bagged minimizing air content, sealed separately, and disposed of in conformance with applicable regulations.

3. Removal of ACM Utilizing Tent Containment Procedure:

a. Tent procedures shall be limited to the removal of less than 260 linear feet and 160 square feet of ACM and shall not result in disturbance of ACM during tent erection.

b. Mist material with amended water and/or foam. Allow sufficient time for the amended water to penetrate the material to be removed.

c. Cut bands, wire or other items placed over insulation or ACM.

d. Remove the ACM using hand tools such as knives or scrapers.

e. Exercise caution when removing ACM.

f. Remove any residual asbestos-containing material from the substrate using wet cleaning methods.

g. Seal exposed ends of remaining insulation or ACM with a "wettable cloth" and/or encapsulant.

h. Place the removed material immediately into a properly labeled fire retardant 6-mil polyethylene bag. All material shall be properly containerized and decontaminated prior to removal from the Work Area.

i. Following the completion of removal of ACM, all visible residue shall be removed from the substrate.

4. Following Removal of ACM Utilizing Tent Containment or Tent/Glovebag Procedure:

a. Clean all visible accumulations of loose ACM. Metal shovels shall not be used within the Work Area.

b. Accumulations of dust shall be cleaned continuously until completion of clean up.

c. After removal of all visible accumulations of ACM, the area shall be:

(1) Wet cleaned using rags, mops or sponges.

(2) Permitted sufficient time to dry, prior to HEPA vacuuming all substrates.

(3) Lightly encapsulated to lockdown residual asbestos. A thin coat of an encapsulating agent shall be applied to any surfaces in the Work Area which were not the subject of removal or other remediation activities. In no event shall encapsulant be applied to any surface that was the subject of removal or other remediation activities prior to obtaining satisfactory clearance air monitoring results. Asbestos abatement contractor shall request and pass a visual inspection performed by the consultant before proceeding to the next step. Documentation of passing this inspection shall be recorded in a daily logbook.

(4) The Third-Party Air Monitor will conduct a visual observation of the Work Area to verify the absence of asbestos-containing waste materials.

(5) If the Work is accepted by the Third-Party Air Monitor based on the inspection, asbestos abatement contractor shall be notified. Conduct the following activities in accordance with the contract and all applicable laws, codes, rules and regulations.

(a) All waste shall be removed from the Work Area and holding areas.

(b) All tools and equipment are to be removed and decontaminated in the decontamination enclosure system.

(6) If the Work is not approved, the Third-Party Air Monitor will inform Asbestos abatement contractor who will then HEPA-vacuum and/or wet-clean the Work Area. The Third-Party Air Monitor will then perform a subsequent visual observation. This process will continue until the Third-Party Air Monitor accepts the Work Area as clean.

(7) The Work Area shall be vacated for a minimum of one hour to allow fibers to settle prior to clearance air monitoring, when required.

d. Final Barrier Removal

(1) Upon receipt of acceptable clearance testing results polyethylene sheeting (inside layers) and Isolation Barriers shall be removed and disposed accordingly as ACM. The tent shall be collapsed inward, enclosing the contaminated clothing. This contaminated material shall be disposed of in another plastic bag. The HEPA vacuum shall be decontaminated and sealed.

(2) The area surrounding the abatement work place shall be cleaned of any visible debris utilizing HEPA-vacuum and wet methods.

e. The Third-Party Air Monitor will conduct a final visual inspection. Approval must be granted prior to break down of decontamination facility and asbestos abatement contractor demobilization. Other Information: Extra time required to clean Work Areas in order to achieve clearance criteria shall not be considered grounds for an extension of time for contract completion.

4.02 MAINTENANCE OF CONTAINED WORK AREA AND DECONTAMINATION ENCLOSURE SYSTEMS

A. Ensure that barriers are installed in a manner appropriate to the expected weather conditions during the project and for its duration. Repair damaged barriers and remedy defects immediately upon their discovery. Visually inspect barriers at the beginning and end of each work period.

B. Visually inspect non-Work Areas and the decontamination enclosure system for water leakage. Check the floor below, ceiling and walls, and view beneath/or around the decontamination enclosure system, for signs of leakage. Perform the visual inspection a minimum of two times for each 8-hour work shift.

PART 5 – ASBESTOS WASTE MANAGEMENT

5.01 ACM WASTE REQUIREMENTS

A. The asbestos abatement contractor and all sub-asbestos abatement contractors are specifically alerted to the illegal practice of combining asbestos-containing waste (ACW) from one project with the ACW of other projects without using the services of a permitted waste transfer station as defined by 6 NYCRR Part 360 and 364. As part of the shop drawing submittals, the Asbestos abatement contractor

must submit for approval the proposed method of transportation and disposal that will be utilized to manage the ACW of this Contract. If a permitted transfer station is to be used, the cost shall be included in the work. The asbestos abatement contractor must submit a waste manifest consistent with whatever approved method is utilized as part of the invoicing and payment procedures.

B. The asbestos abatement contractor shall maintain compliance with the strictest set of regulations of Title 15, Chapter 1 of RCNY, NYC LL 70/85, NYS DOL ICR 56, USEPA, Asbestos Regulation 40 CFR Section 61.152, 29 CFR 1926.1101, 29 CFR 1910.1200 (F) of OSHA's Hazard Communication Standards, and other applicable standards.

NOTE: Any penalties incurred for failure to comply with any of the above regulations will be the sole responsibility for fines imposed due to negligence of the Asbestos abatement contractor.

C. When presenting ACW for storage at the generation site, the Asbestos abatement contractor shall:

1. Wet down ACW in a manner sufficient to prevent all visible emissions of dust into the air.

2. Seal material in a leak tight container while wet.

3. Keep ACW separate from any other waste.

D. When presenting ACW for storage away from the site of generation, the Asbestos abatement contractor shall:

1. Ensure that ACW has been properly packaged as per requirements above.

2. Examine the containers of ACW to ensure that there are no breaks in the containers and that no visible dust is being released into the air.

3. If examination reveals damage to a container of ACW the Asbestos abatement contractor or person accepting the waste shall immediately wet down the ACW and repackage it into a clean leak tight container. The subsequent repackaging shall be the financial responsibility of the Asbestos abatement contractor and occur at no extra cost to the City.

4. Keep ACW separate from any other waste.

E. When storing ACW – The Asbestos abatement contractor shall:

1. Ensure that the ACW has been sufficiently wetted down in tight containers.

2. Re-wet and repackage any damaged containers.

3. Maintain at storage site an adequate supply of spare leak tight containers.

4. Maintain at storage site an adequate supply of amended water.

5. Keep ACW separate from any other waste.

6. Keep ACW in a secured, enclosed, and locked container.

7. If the Asbestos abatement contractor has intention of sorting a quantity of ACW greater than or equal to 50 cubic yards, the Asbestos abatement contractor shall:

   a. Submit a written request and receive written approval from the City.

F. When presenting for transport, the Asbestos abatement contractor shall:

1. Ensure that ACW has been sufficiently wetted down.

2. Examine the integrity of the container's airtight seal.

3. Re-wet and repackage any damaged containers.

4. Keep ACW separate from all other waste.

5. Ensure that a person transporting asbestos waste holds a valid permit issued pursuant to law.

6. Frequency of Waste Removal:

   a. Properly packaged and labeled asbestos waste shall be removed from the site on a daily basis. Under no circumstance shall asbestos waste be stored on site without written approval from the City. The Waste Hauler and landfill shall be as indicated on the notifications to regulatory agencies.

G. Waste Load-out Through Equipment Decontamination Enclosure (Full Decontamination Facility): Place asbestos waste in disposal bags. Large items not able to fit into disposal bags shall be wrapped in one layer of 6-mil thick polyethylene sheeting. Clean outer covering of asbestos waste package by wet cleaning and/or HEPA-vacuuming in a designated part of the Work Area. Move wrapped asbestos waste to the equipment washroom, wet clean each bag or object and place it inside a second disposal bag, or a second layer of 6-mil polyethylene sheeting, as the item's physical characteristics demand. Air volume shall be minimized, and the bags or sheeting shall be sealed airtight with tape.

1. The clean containerized items shall be moved to the equipment decontamination enclosure holding area pending load-out to storage or disposal facilities.

2. Workers who have entered the equipment decontamination enclosure system from the uncontaminated non-Work Area shall perform load-out of containers from the decontamination enclosure holding area. Dress workers moving asbestos waste to storage or disposal facilities in clean overalls of a color different than from that of coveralls used in the Work Area. Ensure that workers do not enter from uncontaminated areas into the equipment washroom or the Work Area. Ensure that contaminated workers do not exit the Work Area through the equipment decontamination enclosure system.

3. Thoroughly clean the equipment decontamination enclosure system immediately upon completion of the waste load-out activities, and at the completion of each work shift.

4. Labeled ACM waste containers or bags shall not be used for non-ACM debris or trash. Any materials placed in labeled containers or bags, including those turned "inside-out", shall be handled and disposed of as ACM waste.

H. All asbestos materials, wastes, shower water, polyethylene, disposable equipment and supplies shall be disposed of as asbestos contaminated waste, in accordance with the EPA regulation (40 CFR, Section 61.150) and those requirements of the New York Department of Environmental Conservation and New York City Department of Sanitation.

I. All asbestos materials shall be prepared for transportation in accordance with this specification and all applicable Federal, State, County and City Regulations. asbestos abatement contractor shall submit the following documentation:

1. Where applicable, an EPA Generator's identification number which has been obtained from the EPA for all asbestos waste generated from the project.

2. Applicable State Waste Hauler license and registration numbers.

3. Federal Hazardous Materials Waste Hauler number.

4. Designated landfill EPA Permit numbers.

J. Prior to loading asbestos waste the enclosed cargo areas (dumpster) shall be prepared as follows:

1. Clean via HEPA-vacuum and wet wipe techniques the enclosed cargo areas of all visible debris prior to preparing with polyethylene.

2. Line the cargo area with two layers of 6-mil polyethylene sheeting to prevent contamination from damaged or leaking containers. Floor sheeting shall be installed first and extend up the walls a minimum of 24-inches. Wall sheeting shall be overlapped and taped securely into place.

K. Asbestos-containing waste shall be placed on level surfaces in the cargo area of the dumpster and shall be packed tightly to prevent any shifting or tipping of the waste during transportation.

L. Asbestos-containing waste shall not be thrown into or dropped from the dumpster. All material shall be handled carefully to prevent rupture of the containers.

M. All personnel engaged in handling and loading of asbestos contaminated waste outside of the Work Area shall wear protective clothing. The disposable clothing shall include head, body and foot protection and color of clothing shall be different from abatement personnel in the Work Area. Minimum respiratory protection shall be half face, dual cartridge, air purifying respirators with HEPA-filters.

N. Asbestos abatement contractor shall immediately clean debris or residue observed on containers or surfaces outside of the Work Area. Cleaning shall be via HEPA equipped wet/dry vacuums only.

O. All asbestos-containing waste shall be transported from the abatement site to the landfill by a registered Waste Hauler. When transporting ACW:

1. Ensure that the ACW has been sufficiently wetted down in a leak tight container.

2. Re-wet and repackage any damaged containers.

3. Maintain at storage site an adequate supply of spare leak tight containers.

4. Maintain at storage site an adequate supply of amended water.

5. Keep ACW separate from any other waste.

P. Keep ACW in a secured, enclosed, and locked container.

Q. Waste transport documents shall conform to the requirements of the U.S. Department of Transportation, Hazardous Materials Transportation Regulation, 49 CFR Part 173 and EPA 40 CFR 61.150 (d)(1)(2). Shipping documents shall be clearly marked with the required designation "RQ Asbestos". Asbestos abatement contractor shall provide a copy of this document to the City.

R. A uniform hazardous waste manifest shall be prepared by the asbestos abatement contractor and signed by the asbestos abatement contractor each time the asbestos abatement contractor ships a dumpster load of Asbestos-Containing Waste

Material. The uniform hazardous waste manifest shall include the site of waste generation, the names and addresses of the Transporter, the asbestos abatement contractor, and the landfill operator with information on the type and number of asbestos-waste containers, time and date. Asbestos abatement contractor shall provide the Construction Project Manager, Third-Party Air Monitor or authorized designated representative with signed copies of the waste manifest before each departure.

S. Asbestos abatement contractor or his registered hazardous Waste Hauler shall transport asbestos-containing waste material from the abatement site directly to the specified disposal site. Asbestos abatement contractor or their Waste Hauler shall not accept material from any other site when transporting asbestos-containing waste material from the abatement site. The authorized DDC representative or Construction Project Manager reserves the right to travel with asbestos abatement contractor's Waste Hauler to the waste disposal site. No intermediate storage of waste material (i.e., asbestos abatement contractor's warehouse) shall be permitted.

T. Final or progress application for payments will not be processed unless all hazardous waste manifests generated to date have been received and reviewed by the Construction Project Manager.

U. All asbestos materials, wastes, shower water, polyethylene disposable equipment and supplies shall be disposed of as asbestos contaminated waste, in accordance with the EPA regulation (40 CFR, Section 61.150) and those requirements of the New York State Department of Environmental Conservation and the New York Department of Sanitation.

V. Asbestos abatement contractor shall transport all sealed drums to a landfill disposal site approved by the Department of Environmental Conservation and the EPA. Transportation shall be performed by a New York State registered Waste Hauler, where required. When presenting the ACW for disposal the Asbestos abatement contractor or sub Asbestos abatement contractor shall:

1. Ensure that waste container is properly labeled according to the National Emission Standard for Hazardous Air Pollutants (NESHAP); Asbestos Revision, 40 CFR, Part 61, Subpart M. The labels shall include the name of the waste generator and the location where the waste was generated.

2. Comply with all applicable orders issued pursuant to asbestos disposal.

3. Ensure that ACW has been sufficiently wetted down.

4. Re-wet and repackage any damaged containers.

5. Keep ACW separate from all other wastes.

W. Asbestos abatement contractor shall notify the waste disposal site, at least 24 hours prior to transportation of asbestos contaminated waste to be delivered. Asbestos abatement contractor shall determine if a larger notification period is required.

X. At the site asbestos abatement contractors or Waste Hauler trucks shall approach the dump location as close as possible for unloading asbestos waste. Containers shall be carefully placed in the ground. Do not throw containers from truck.

Y. Asbestos abatement contractor or Waste Hauler shall inspect containers as they are unloaded at the disposal site. Material in damaged containers shall be repacked in empty containers, as necessary.

Z. Asbestos abatement contractor or Waste Hauler shall not remove asbestos-containing waste Material from drums unless required to do so by the disposal site City. Used drums shall be disposed of as asbestos-asbestos contaminated waste.

AA. All personnel engaged in unloading of the containers at the waste site shall wear protective clothing. The disposable clothing shall include head, body and foot protection. Minimum respiratory protection shall be half face, dual cartridge, air purifying respirators with HEPA-filters. Workers shall remove their protective clothing at the disposal site, place it in labeled disposal bags and leave them with the deposited waste shipment.

BB. For the compaction operation, the asbestos abatement contractor shall ensure that disposal sites personnel have been provided with personal protective equipment by the disposal operator. If the disposal site City has not provided this protective equipment, the asbestos abatement contractor shall supply protective clothing and respiratory protection for the duration of this operation (PAPR respirators are mandatory).

CC. If containers are broken or damaged, the asbestos abatement contractor or Waste Hauler shall, using personnel who are properly trained and wearing proper protective equipment, shall repackage the waste in properly labeled containers. Asbestos abatement contractor shall then clean the entire truck and its contents using HEPA-vacuums and wet cleaning techniques until no visible residue is observed.

DD. Following the removal of all containerized waste, the asbestos abatement contractor shall decontaminate the truck cargo area using HEPA-vacuums and/or wet cleaning techniques until no residue is observed. All 6-mil polyethylene sheeting shall be removed and discarded as asbestos-containing waste material along with contaminated cleaning material and protective clothing, in containers at the disposal site.

EE. The transporter(s) of all asbestos waste shall not back-haul any items on his return from landfill/disposal site.

FF. All asbestos waste shall be disposed of in an approved Asbestos Landfill site only.

1. NO PERSON UNDER ANY CIRCUMSTANCES SHALL ABANDON ACW. The same shall be disposed of only by certified persons in approved landfills.

2. A manifest form will be signed by the Landfill documenting receipt and acceptance of the asbestos-containing waste. This manifest will be furnished to the City of New York within thirty calendar days from the project completion date.

3. It is the responsibility of the Asbestos abatement contractor to determine current waste handling, transportation and disposal regulations for the work site and for each waste disposal landfill. The Asbestos abatement contractor must comply fully with these regulations and all appropriate U.S. Department of Transportation, EPA and other Federal, State and Local entities' regulations and all other current legal requirements.

4. The asbestos abatement contractor shall obtain an agreement from the transporter (s) that the practice of "Back-Hauling" will not be engaged in, with respect to any and all waste loads taken from this site during the work.

5. The asbestos abatement contractor will document actual disposal of the waste at the designated landfill by having completed a Disposal Certificate and will provide a copy of the same to the Department of Design and Construction.

PART 6 – ACCEPTANCE

6.01 ACCEPTANCE

Upon satisfactory completion of all decontamination procedures, a certificate will be issued by the Construction Project Manager with copies to all parties.

A. A letter of Compliance stating that all the work on the project was performed in accordance with the Specifications and all applicable Federal, State and Local regulations.

B. All warranties as stated in the Specifications.

END OF SECTION 028213

SECTION 07 84 00

FIRESTOPPING/SMOKE SEALS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Provide firestopping at all penetrations and juncture joints of fire-rated walls, floors and ceilings in accordance with the requirements of the NYC Building Code.

B. Firestopping and Smoke Seals shall be provided, but not limited to the following specific locations:

1. Penetrations for the passage of duct, cable, conduit, piping and electrical raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor slabs and floor/ceiling assemblies), and vertical service shafts.

2. Openings and penetrations in fire-rated partitions or walls containing fire doors.

3. Locations shown specifically on the Drawings.

1.2 REFERENCES

A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

1. American Society for Testing and Materials (ASTM)

2. Underwriters Laboratories, Inc. (UL)

3. National Fire Protection Association (NFPA)

4. Warnock Hersey

1.3 DEFINITIONS

A. Penetration: Any opening or foreign material passing through or into a fire-rated barrier.

B. Fire-Rated: Have the ability to withstand the effects of a standard fire exposure for a specified time period, as determined by qualified testing.

C. Fire-Rated Barrier: A floor, wall, partition or floor-ceiling assembly able to withstand a standard fire and hose stream test without failure.

D. Fire resistance rating: The ability of a structure to act as a barrier to the spread of fire and to confine it to the area of origin. Ratings are expressed in hours and apply to beams, columns, floors, ceilings, roofs, walls and partitions.

E. Firestopping: A means of sealing openings in fire-rated barriers to preserve or restore the fire resistance rating.

F. Firestop System: A material, or combination of materials, installed to retain the integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke or gases through penetrations in fire-rated barriers.

G. F Rating: The time period that the through-penetration firestop system limits the spread of fire through the penetration when tested in accordance with ASTM E814.

H. T Rating: The time period that the penetration firestop system, including the penetrating item, limits the maximum temperature rise to 325°F (163°C) above its initial temperature through the penetration on the non-fire side when tested in accordance with ASTM E814.

1.4 DESIGN REQUIREMENTS

A. Technical Requirements

1. Firestopping materials shall be UL Classified as "Fill, Void or Cavity Material" for use in Through-Penetration Firestop Systems.

2. Firestop Systems shall provide a fire resistance rating at least equal to the hourly resistance rating of the fire-rated barrier and resist passage of smoke and other gases.

B. General Considerations

1. Firestop Systems do not re-establish the structural integrity of load bearing partitions. The Contractor shall consult the Commissioner prior to penetrating any load bearing assembly.

2. Firestop systems are not intended to support live loads or traffic. Contractor shall consult the Commissioner if there is reason to believe these limitations may be violated.

1.5 SUBMITTALS

A. Product Data

1. Submit manufacturer's product information for each type of firestopping/smoke seal and assembly installed, including application instructions and specifications.

B. Shop Drawing

1. Submit shop drawings of each firestopping or smoke seal system/assembly to be installed in the project, showing all parts of the system, required clearances.

C. Quality Control Submittals

1. Certificates

a. Furnish manufacturer's certification that materials meet or exceed specification requirements for each of the performance tests specified in Part 2. Provide testing certification.

b. Furnish applicator's certification that material has been completed as specified to meet fire resistance ratings, thickness requirements, and application requirements of the applicable assembly.

c. Furnish UL, BSA, MEA, or OTCR approval of material.

d. Furnish certificate stating each material is 100% asbestos free.

2. Contractor Qualifications

a. Provide proof of Manufacturer and Applicator qualifications specified under "Quality Assurance".

D. Guarantee

1. Contractor and installer's installation guarantee.

1.6 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer: Company specializing in the manufacture of firestopping/smoke seal materials to be used in this Contract shall have a minimum of five years experience.

2. Installer: All firestopping Work shall be performed by a Subcontractor who will be acceptable to the firestopping manufacturer in the application of its products and systems and have a minimum of three years experience and shall have worked on at least two projects with similar quantities of materials used. .

B. Regulatory Requirements

1. Building Code: Material and application shall meet the requirements for firestopping materials in accordance with the NYC Building Code.

2. Material must have UL or NYC BSA, MEA or OTCR approval for each assembly utilized. Comply with the following for firestopping that is required to be in compliance with BC 712 of the 2008 NYC Building Code:

a. ASTM E84 - Surface Burning Characteristics of Building Materials.

b. ASTM E814 - Fire Tests of Through Penetration Firestops.

c. U.L. 1479 - Fire Tests of Through-penetration Firestops.

d. U.L. - Fire Resistance Directory; Through-Penetration Firestop Systems (XHEZ), and Fill, Void or Cavity Materials (XHHW).

e. U.L. 723 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. Manufacturer's Certification

1. Manufacturer shall provide written certification stipulating that its products and systems used in this Project, if installed in accordance with the manufacturer's recommendations, shall provide the firestopping specified in this Section, as indicated by its UL rating for that specific installation.

2. The certification shall not include either or both of the following statements, or variations thereof:

"Owner or User shall determine suitability of the product or system for its intended use and assume all risks and liabilities connected therewith".

and,

"Owner or User shall test application of product or system for its specific use".

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages bearing name of manufacturer, product identification, and the proper UL labels for fire hazard and fire-resistance classification.

B. Reject damaged packages found unsuitable for use and remove from job site.

C. Store materials off ground, under cover, and away from damp surfaces.

D. Keep materials dry at all times. Wet material shall be discarded.

E. Rotate stock material and use prior to expiration date.

1.8 GUARANTEE

A. Submit a guarantee, executed by the Contractor and co-signed by the installer, agreeing to repair/replace firestopping work performed under this Contract which has cracked, flaked, dusted excessively, peeled, or has separated or fallen from the substrate due to defective workmanship for a period of two (2) years from the date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hilti Construction Chemicals, Inc., Tulsa, OK.

B. The Carborundum Company, Niagara Falls, NY.

C. 3M Fire Protection Products, St. Paul, MN.

D. Bio Fireshield, Inc., Concord, MA

E. Tremco Sealant Division, Tremco LTD, Toronto, Ontario, Canada.

F. Specified Technologies, Inc., Somerville, NJ

G. W. R. Grace & Co., Macungie, PA

H. RectorSeal Corp., Houston, TX

2.2 MATERIALS

A. Grout and sealant systems, as well as integral firestopping sleeves and membranes, shall meet or exceed requirements as specified in Part 1 of this Section and shall be acceptable to the Authority.

B. Listing of manufacturer does not mean that manufacturer has firestopping assemblies for all conditions to be encountered in the Work. Contractor is responsible for selection of material and system appropriate to the condition.

C. Firestopping systems shall meet the requirements of ASTM E814, which include, but are not limited to, the following:

1. Prevent flame pass-through.

2. Restrict temperature to not exceed 325°F over ambient on side of assembly opposite flames.

3. Provide a positive smoke seal.

4. Withstand hose stream test with a minimum positive pressure differential of 0.01 inch (2.49 pa.)

5. Provide an F rating of not less than the required fire rating of the wall penetrated.

6. Provide an F rating and a T rating for floor penetrations of not less than 1 hour, but not less than the required fire rating of the floor penetrated, except as follows:

a. Floor penetrations contained and located within the cavity of a wall do not require a T-rating.

b. Metallic piping or tubing penetrating a single fire rated floor, having a maximum 6" diameter can be firestopped with concrete, grout or mortar of thickness to maintain the fire rating of the floor penetrated. No limit to the number of floors penetrated if the area of the penetration does not exceed 144 square inches in any 100 square feet of floor area.

D. Firestopping materials shall be asbestos-free, emit no toxic or combustible fumes and be capable of maintaining an effective barrier against flame, smoke, gas, and water in compliance with requirements of this Section.

E. Firestopping materials/systems shall be flexible to allow for normal movement of building structure and penetrating items(s) without affecting the adhesion or integrity of the system.

F. Firestopping materials shall not require hazardous waste disposal of used containers/packages.

G. On insulated pipe, the fire-rating classification must not require the removal of the insulation.

H. Firestopping materials shall be free of solvents. Shrinkage while curing shall not exceed shrinkage experienced during specified testing. Firestopping shall remain in complete contact with adjacent construction when fully cured.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine and confirm the compatibility of surfaces to receive firestopping materials. Verify that surfaces are sound, clean and dry and are ready to receive the firestopping.

B. Verify that penetration elements are properly located and securely fixed, with the proper space between the penetration element and surfaces of the opening.

3.2 PREPARATION

A. Protect adjacent surfaces and equipment from damage.

B. Clean surfaces of opening.

3.3 INSTALLATION

A. Install firestopping system in strict accordance with the manufacturer's instructions to obtain/maintain the fire-rating required at the specific location. The Contractor and the Authority shall be immediately notified of conditions that will not allow the proper installation of the material to achieve the required rating, such as the annular space between the penetration and sleeve not being wide enough to meet the requirements of the assembly.

B. Provide escutcheons for piping at each side of penetration when subject to view and/or if required by the UL assembly.

3.4 FIELD QUALITY CONTROL

A. Special Inspection

1. The Authority will assign under the requirements of Section 1704.25 of the 2008 NYC Building Code a Special Inspector who will inspect the firestopping/smoke seal installation to meet both the Special and Progress Inspection requirements of the 2008 NYC Building Code.

2. The Special Inspector will make inspections and any testing deemed necessary.

3. Special/Progress inspections will be performed in accordance with both paragraphs 10.9.1 (witnessing) and 10.9.2 (destructive verification) of ASTM E2174. The inspector will witness and verify firestopping and smoke sealing installations. The installation process of a minimum of 10% of all firestopping/smoke seals shall be witnessed and 2% of all firestop/smoke seal installations will be verified utilizing destructive means.

B. Nonconforming Firestopping/Smoke Seal Installation

1. When inspection indicates firestopping does not comply with the required assembly, remove and replace firestopping. Failures will result in additional areas of destructive testing.

2. Areas of repair or replacement will be reinspected for compliance to the approved assembly. The costs for additional inspections and testing as required by the inspector shall be borne by the Contractor.

C. Contractors Responsibility for Quality Control

1. Inspect all installations to ensure that all work meets the requirements specified as the Work progresses.

2. Cooperate with the Special Inspector performing Special and Progress Inspections. Provide all access, including scaffolding and ladders. Provide a minimum of 72 hours notice prior to each day of firestopping installation to ensure Inspector is available to witness or verify the requisite number of installations.

3. The Contractor shall include all cost of complying with inspections performed in accordance with ASTM E2174.

4. Do not cover firestopping work until it is accepted and approved by the Special Inspector.

5. The Contractor shall include repair of all firestopping and smoke sealing damaged as a result of the ASTM E2174 destructive verification requirements.

6. The Contractor shall replace all firestopping/ smoke sealing of a certain type if 10% of the witnessed or verified types are determined to be non-compliant. This replacement shall be at no cost to the SCA.

3.5 CLEANING

A. Remove excess materials, droppings, and debris; remove excess materials from adjacent surfaces.

3.6 PROTECTION

A. Protect firestopping installations from damage until completion of all Project Work.

END OF SECTION

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SECTION 08 31 13

ACCESS DOORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide all access doors and frames located in walls and in ceilings, complete with accessories, as indicated on the Drawings and as specified herein.

1.2 REFERENCES

A. References and industry standards listed in this section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

1. New York City Building Code

1.3 SUBMITTALS

A. Product Data

1. For each type of door and frame indicated. Include catalogue cuts, construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.

B. Shop Drawings

1. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation. Indicate locations of fire rated doors on schedule.

C. Certification and listing by an Approved Agency in accordance with NYC Dept. of Buildings rules, indicating that the materials and assemblies as regulated by the NYC Building Code is acceptable for the intended use. When test methods are stipulated in the NYC Building Code, the tests utilized shall be stated in the Certification. Prior MEA and BSA approvals are acceptable for materials conforming to current Code requirements.

1. Fire rated access doors are regulated assemblies.

D. Keys

1. Furnish 6 keys for all locks

1.4 QUALITY ASSURANCE

A. Fire rated Doors

1. Fire Rated Access Doors for Walls: Complete assemblies meeting NYC Building Code requirements for 1½ hour rating for a 2-hour wall. Each assembly shall be labeled by an agency approved pursuant to rules of the NYC Dept. of Buildings. The label shall meet Building Code requirements and shall be permanently affixed at the factory.

2. Fire Rated Access Doors for Ceilings: Complete assemblies complying with NYC Building Code requirements for one-hour combustible and one-hour non-combustible floor/ceiling systems. Each assembly shall be labeled by an agency approved pursuant to rules of the NYC Dept. of Buildings. The label shall meet Building Code requirements and shall be permanently affixed at the factory.

1.5 COORDINATION

A. Verification: Determine specific locations for access doors needed to gain access to for installation of concealed conduit and wiring, and indicate on schedule specified in "Submittals" Article.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle access doors and frames as recommended by the Manufacturer, to protect from damage.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Karp Associates, Inc., Maspeth, NY 11378

B. Milcor, Inc., Lima, OH 45804

C. Nystrom Building Products, Minneapolis, MN 55413

D. Approved Equal

2.2 NON-FIRE RATED ACCESS DOORS

A. Frames: Minimum 16 gage steel.

1. Flange: Integral concealed flange.

2. Gypsum Board Applications: Provide frame with gypsum board bead for concealed flange installation.

B. Flush Type Door Panel: Minimum 14 gage steel.

1. Hinges: Concealed spring type set to open to approximately 175°; sufficient number to support the door size, or continuous type hinge.

2. Finish: Factory-applied rust inhibitive baked enamel primer over phosphate treated steel. Color of finish shall match color of exiting adjacent surface.

C. Cam Locks: Flush, screwdriver operated; sufficient number to hold door panel in flush, smooth plane when closed.

2.3 FIRE RATED ACCESS DOORS FOR CEILINGS

A. Frames: Minimum 16 gage steel, with integral flange 1" wide.

1. Anchorage: predrilled holes in frames for anchoring with fasteners.

B. Flush Type Door Panel: Minimum 20 gage steel double wall construction with insulation, equipped with automatic closer and inside release mechanism.

1. Hinge: Continuous, set to open approximately 175°.

2. Finish: Factory-applied baked enamel primer over phosphate-treated steel. Color of finish shall match color of existing adjacent surface.

C. Automatic Latches: Direct action knurled knob or turn ring, of sufficient quantity to hold door panel in flush, smooth plane when closed.

1. One latch on each door panel shall be key-operated, pin tumbler type.

2. Locking Device: Self-latching key operated cylinder lock. Furnish 6 keys total.

2.4 FABRICATION AND MANUFACTURE

A. Manufacture access door assemblies as integral units complete with all parts and ready for installation. Fabricate units of continuous welded steel construction unless otherwise indicated or specified. Grind welds smooth and flush with adjacent surfaces. Attachment devices shall be of size and type required to secure access doors to types of supports indicated on the Drawings.

1. Allowable Size Variations: Manufacturer's standard size units that vary slightly from the sizes indicated may be acceptable, subject to the approval of the Commissioner.

2.5 PAINT

A. Shop Primers: Provide primers that comply with Division 9 Section "Painting" and finish to match color of existing adjacent surface.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the access doors in accordance with the manufacturer's printed installation instructions, except as shown or specified otherwise.

B. Coordinate access door installation with installation of supporting construction.

C. Set units accurately in position and securely attach to support with face panel plumb or level in relation to adjoining finish surface.

3.2 ADJUSTMENT

A. Adjust hardware and doors for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

3.3 LOCATION

A. Provide non-fire rated access doors in non-fire rated construction and fire rated access doors in fire rated construction.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide all materials, labor and equipment to properly install the following Work:

1. Gypsum wallboard.
2. Gypsum board ceilings and soffits.
3. All accessory components.

1.2 REFERENCES

A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

B. American Society for Testing and Materials (ASTM), latest editions.

A641	Zinc-Coated (Galvanized) Carbon Steel Wire.
A653/A653M	General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process
C11	Standard Terminology Related to Gypsum and Related Building Materials and Systems
C36	Gypsum Wallboard
C442	Gypsum Backing Board
C473	Standard Test Methods for Physical Testing of Gypsum Panel Products
C475	Joint Treatment Materials for Gypsum Wallboard Construction
C630	Water Resistant Gypsum Backing Boards

C645	Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board
C665	Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
C754	Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board or Water Resistant Backing Board
C834	Standard Specification for Latex Sealants
C840	Specification for Application and Finishing of Gypsum Board
C919	Practices for Use of Sealants in Acoustical Applications
C1002	Steel Drill Screws for the Application of Gypsum Board
C1047	Standard Specification for accessories for Gypsum Wallboard and Gypsum Veneer Base
C1278	Standard Specification for Fiber-Reinforced Gypsum Panel
C1325	Standard Specification for Non-Asbestos Fiber Mat Reinforced Cement Interior Substrate Sheets
C1388	Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
C1396	Standard Specification for Gypsum Board
D2020	Standard Test Methods for Mildew (Fungus) Resistance of Paper and Paperboard
D3273	Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
E84	Surface Burning Characteristics of Building Materials
E119	Fire Tests of Building Construction and Materials
G21	Standard Practice for determining Resistance of Synthetic Polymeric Materials to Fungi

C. Gypsum Association

GA-600	Fire Resistance Design Manual
GA-214	Levels of Finishes
GA-216	Recommended Specifications for the Application and Finishing of Gypsum Board
GA-505	Gypsum Board Products - Glossary of Terminology

D. Underwriters Laboratories Inc. (UL)

1. Fire Resistance Directory.

E. Tile Council of America

1. Handbook for Ceramic Tile Installation.

F. International Code Council, ICC-ES (Evaluation Service)

1. AC86 - Acceptance Criteria for Cold-Formed Steel Framing Members – Interior Non load-bearing Wall Assemblies.

G. American Iron and Steel Institute (AISI)

1. AISI S905 – Test Methods for Mechanically Fastened Cold-Formed Steel Connections
2. AISI Standard for Cold-Formed Steel Framing - General Provisions
3. AISI NASPEC

1.3 SUBMITTALS

A. Product Data

1. Submit manufacturers' product information, specifications, and installation instructions for the following products: mold and moisture resistant gypsum board, joint compounds, control joints, joint reinforcing, and all related accessories.

B. Shop Drawings

1. Submit drawings indicating sizes and locations of steel grounds for attachment and support of signs, other accessories, fixtures, furnishings, finishes, and equipment.

C. Materials Certificates and Acceptances

1. Submit certificates from the manufacturers of the specified materials stating compliance with the applicable requirements set forth for all materials specified in this Section.

2. Submit certification and listing by an Approved Agency in accordance with NYC Dept. of Buildings rules, indicating that the materials and assemblies as regulated by the NYC Building Code are acceptable for the intended use. When test methods are stipulated in the NYC Building Code, the tests utilized shall be stated in the certification. Prior MEA and BSA approvals are acceptable for materials conforming to current Code requirements.

3. Submit written acceptances from the wallboard manufacturer accepting the type of fasteners to be used for each type of wallboard.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Installer shall be a firm with not less than three (3) years of experience relevant to the installation of specified materials.

B. Regulatory Requirements

1. Building Code: Work of this section shall conform to all requirements of N.Y.C. Building Code.

2. New York City Board of Standards and Appeals (BSA), and New York City Materials Equipment Acceptance (MEA) approvals are acceptable for materials and assemblies conforming to current NYC Building Code requirements.

3. Fire-Resistance Ratings

a. Comply with fire-resistance ratings as required by governing authorities and codes. Provide certification and listing by an Approved Agency in accordance with NYC Dept. of Buildings rules, indicating that the materials and assemblies as regulated by the NYC Building Code are acceptable for the intended use.

b. Provide materials, accessories and application procedures which have been listed by UL or tested in accordance with ASTM E119 for the type of construction shown. Provide materials and construct assemblies which qualify for required fire resistance classifications in accordance with the Gypsum Association "Fire Resistance Design Manual" as referenced in the Building Code of the City of New York, or in accordance with the acceptance requirements of the New York City MEA or BSA.

C. Industry Standards

1. Comply with applicable requirements of ASTM C840, except where more detailed or more stringent requirements are indicated, including the recommendations of the manufacturer.

D. Single Source Responsibility

1. Obtain all steel studs and other metal framing components and accessories from a single manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer.

B. Store all materials inside, under cover, in a manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards to prevent sagging. Do not store at temperature exceeding 125°F.

C. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal framing members, corner beads, and trim from being bent or damaged.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of a specified manufacturer.

Products which vary slightly from specified criteria will be considered for acceptance upon submission of a written explanation and complete

technical data to the Authority. Written authorization from the Authority is required prior to installation of such materials whether or not the manufacturers are listed herein.

B. Gypsum board and related products: Gypsum board shall be mold and moisture resistant.

1. SHEETROCK brand Mold Tough Gypsum Panels, USG Corporation.

2. SHEETROCK brand Mold Tough Gypsum Liner Panels, USG Corporation.

3. Gold Bond brand XP Fire-Shield Wallboard, National Gypsum Company, Charlotte, NC.

C. Metal Support Materials

1. Marino\Ware, South Plainfield, NJ.

2. ClarkDietrich Building Systems, West Chester, OH.

3. Super Stud Building Products Inc., Edison, NJ.

4. United States Gypsum Co., Chicago, IL.

2.2 MATERIALS

A. Metal Framing

1. Fasteners for Metal Framing

a. Provide fasteners of type, size, style, grade, holding power, class, and other properties required for secure installation of framing and furring. Galvanize all fasteners and accessories. Powder actuated fasteners shall not be used in occupied areas of a building.

B. Gypsum Board

1. General: Panels shall be mold and moisture resistant, meeting a minimum average panel score of "10" in accordance with ASTM D3273. Panels shall not contain asbestos.

2. Paper faced gypsum board

a. Gypsum wallboard: provide new to match thickness of existing board.

b. Gypsum board shall be manufactured with a minimum of 90% pre-consumer content materials.

c. Fungi Resistance: Paper facing shall be fungi resistant when tested in accordance with ASTM D2020-03 or D3273.

C. Joint Treatment Materials

1. Jointing System - typical: Comply with ASTM C475. Type recommended by the manufacturer for the application indicated, to prevent cracking, and to meet fire resistance requirements where applicable. Reinforcing tape and compound shall be designed as a system to be used together.

2. Provide setting type or ready-mixed drying type joint compound as recommended by the board manufacturer for each type of board, for joints, fastener heads and cut edges of board.

3. Jointing compound shall be asbestos free.

D. Miscellaneous Materials

1. General: Provide auxiliary materials for gypsum board work of the type and grade recommended by the gypsum board manufacturer.

2. Gypsum board Screws:

a. Comply with recommendations of the wallboard and metal framing manufacturers and ASTM C1002.

b. For fastening the gypsum board in place, specially designed for use with power-driven tools, of length recommended for application in board manufacturers printed instructions, but not less than 1¼" long, with self-tapping threads and self-drilling points. Screws shall be steel with rust inhibitive coating.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Inspection

1. Prior to installation of the Work of this Section, carefully inspect the installed Work of all other trades and verify that all such Work is

complete to the point where this installation may properly commence.

2. Do not install gypsum board in any location where it may be directly exposed to water.

3. Installation shall comply with manufacturer's recommendations as approved by the Authority, with all pertinent codes and regulations as a minimum standard.

B. Coordination of Work

1. Coordinate Work of this Section with the Work of other Divisions which have items installed in, on or contiguous to gypsum board assemblies.

C. Verification of Conditions

1. Start of Work constitutes acceptance of existing conditions, Contractor shall bring any discrepancies to the attention of the Authority prior to start of Work.

3.2 ENVIRONMENTAL REQUIREMENTS

A. General

1. Comply with requirements of all referenced application standards and manufacturers recommendations for environmental conditions before, during and after gypsum board application.

B. Environmental Conditions

1. Maintain continuous uniform building temperatures of not less than 55°F and not more than 90°F for a minimum of 48 hours prior to, during and following application of gypsum board and joint treatment materials and until joint and finishing compounds have dried.

2. Conform to more restrictive environmental conditions where required by the manufacturer.

3. Do not install gypsum board in any location where it may be exposed to moisture during the Construction Phase of the Project. Replace any gypsum board that has been exposed to moisture during the Construction Phase.

C. Ventilation

1. Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry hot weather to prevent too rapid drying.

D. Drying Time

1. Provide adequate drying time between coats of joint compound.

3.3 INSTALLATION - CEILING FRAMING

A. Metal Furring for Ceilings and Soffits

1. Install auxiliary framing at openings for access doors.

3.4 INSTALLATION - PANELS

A. Applying and Finishing Panels, General: Comply with manufacturer's printed installation instructions and recommendations based upon Project conditions, ASTM C840, GA-216, and these Specifications, for all gypsum board application and finishing.

1. Provide wallboard panels of type, thicknesses, and number of layers to match existing.

2. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

3. Install the gypsum board with separate boards in moderate contact but not forced into place. At internal and external corners, conceal the cut edges of the board by overlapping covered edges of the abutting boards. Stagger the boards so that corners of any four boards will not meet at a common point except in vertical corners.

4. Fasten the gypsum board with drywall screws as recommended by the gypsum board manufacturer. Drive the required screws with clutch-controlled power screwdrivers. Provide fasteners in gypsum panels according to manufacturer's written recommendations, and as required for fire-resistance-rated assembly. Maximum spacing shall be as follows:

a. Maximum fastener spacing for abuse resistant gypsum board: 8" o.c., except where 12 inches o.c. is recommended by panel manufacturer.

b. Maximum fastener spacing for other panels: 8 inches o.c.

B. Finishing and Joint Treatment

1. Gypsum Board Finish Levels: Finish panels to match existing.

2. Properly prepare surfaces to receive painting and tile finishes to match existing.

C. Control Joints

1. Location of Control Joints in Vertical Surfaces (e.g., Walls)

a. Unless otherwise unfeasible, control joints shall be aligned with the edges of openings in the partition

2. Location of Control joints in Horizontal Surfaces (e.g., Ceilings and Soffits)

a. Unless otherwise unfeasible, control joints shall be aligned with the edges of rectangular openings in the ceiling.

3.5 CLEAN UP AND PROTECTION

A. In addition to the requirements of these Specifications, use all necessary care during execution of this portion of the Work to prevent scattering of gypsum board scraps and dust and to prevent tracking of joint and finishing compound onto floor surfaces. At completion of each segment of installation in a room or space, promptly pick up and remove from the working area all scraps, debris and surplus material of this Section.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide acoustical ceiling Work as indicated on Drawings only where existing acoustical ceiling has been damaged and cannot be replaced with existing. Provide new as specified herein, including the following:

1. Acoustical Mineral Fiber Tile and Panel Ceilings.

a. Lay-in panel installation - exposed grid.

b. Direct (adhesive) installation.

c. Concealed spline installation.

1.2 REFERENCES

A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

B. American Society for Testing and Materials (ASTM), latest edition.

C423	Test Method for Sound Absorption and Sound Absorption Coefficient by the Reverberation Room Method.
C635	Metal Suspension System for Acoustical Tile and Lay-In Panel Ceilings.
C636	Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
D1779	Specification for Adhesion for Acoustical Materials
E84	Surface Burning Characteristics of Building Materials.
E90	Standard Test Method for Laboratory Sound Transmission Class
E119	Method for Fire Tests of Building Construction and Materials.

E413 Determination of Sound Transmission Class

E1264 Standard Classification for Acoustical Ceiling Products.

E1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a common Ceiling Plenum (CAC)

E1477 Standard Test Method for Luminance Reflectance Factor (LR) LR1 >75%

C. AMA -1-II Ceiling Sound Transmission Test By Two-Room Method

D. Underwriters Laboratories Inc. (UL)

1. Fire Resistance Directory

E. Acoustical and Insulation Materials Association, "Job Conditions".

F. New York City Building Code.

G. New York City Board of Standards and Appeals (BSA) approvals; New York City Materials Equipment Acceptance (MEA).

1.3 DEFINITIONS

A. Direct Suspension System

1. Directly fastened to floor or roof construction above.

B. Indirect Suspension System

1. Installed as part of the Work of this Section, as furnished by ceiling system manufacturer to be attached to direct suspension system.

1.4 SUBMITTALS

A. Product Data:

1. Submit manufacturer's product specifications and installation instructions for ceiling materials, indicating compliance with applicable requirements. Include information pertaining to fire performance, flame spread, and smoke development.

B. Shop Drawings

1. Submit shop drawing details indicating the relationship to mechanical and electrical Work and other items penetrating or

connected to the ceiling. Indicate framing and support details for the ceiling Work.

C. Quality Assurance Submittals

1. Affidavit certifying experience of installation company.

2. Certification and listing by an Approved Agency in accordance with NYC Dept. of Buildings rules, indicating that the materials and assemblies regulated by the NYC Building Code are acceptable for the intended use. When test methods are stipulated in the NYC Building Code, the tests utilized shall be stated in the Certification. Prior MEA and BSA approvals are acceptable for materials conforming to current Code requirements.

D. Project Closeout Submittals

1. Guarantee.

1.5 QUALITY ASSURANCE

A. Qualifications

1. Installer is to be a firm with not less than three (3) years of successful experience in the installation of specified materials.

B. Regulatory Requirements

1. Building Code: Work of this Section shall conform to all requirements of the N.Y.C. Building Code and all applicable regulations of other governmental authorities.

2. Certification and listing by an Approved Agency in accordance with NYC Dept. of Buildings rules. Prior MEA and BSA approvals are acceptable for materials conforming to current Code requirements.

C. Fire Performance Characteristics

Provide ceiling components that are identical to those tested for the following fire performance characteristics, according to ASTM test method, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify ceiling components with appropriate marking of applicable testing and inspecting agency.

1. Surface Burning Characteristics: Tested per ASTM E84. Tested surfaces shall be the surfaces facing the occupied space.

a. Flame Spread: 25 or less.

b. Smoke Developed: 25 or less.

2. All materials exposed to the airflow in ceiling cavity plenums used for supply, return, or exhaust air shall be non-combustible or have a maximum smoke developed index/rating of 50, as defined by and in accordance with NYC Construction Code Sections BC 719 and MC 602. Flame spread index shall not exceed 25. Tested surfaces shall be the surfaces facing the plenum.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Deliver all acoustical units in manufacturer's original, unopened packages fully identified with type, finish, performance data and compliance labeling.

B. Storage

1. Store materials where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.

2. Store tile containers in space where they will be installed for at least 24 hours prior to installation to stabilize moisture content and temperature.

C. Handling

1. Handle ceiling units carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Space Enclosure

1. Do not install interior acoustical ceilings.

1.8 GUARANTEE

A. Work showing defects in workmanship or materials within the one year guarantee period specified in the Contract shall be corrected as directed by the Commissioner. Defects include but are not limited to:

1. Tiles improperly secured.

2. Tiles showing discoloration or cracking.

3. Tiles warping, sagging, or deforming.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, MODELS

A. Acoustical Tile

1. Mineral Composition Tile

Sag resistance to at least 104ºF, 90% RH.

a. Armstrong World Industries

b. CertainTeed Corporation

c. USG Interiors Inc.

2.2 MATERIALS - ACOUSTICAL TILES

A. Mineral Fiber Tile

1. Provide units per ASTM E1264; of designation, style, finish, color, edge detail and size as the existing damaged units. Direct (Adhesive) Installation on Gypsum Drywall:

Style:	Match existing
Size:	Match existing
Edge Profile:	Match existing
Weight:	1.05 lbs./sq.ft. min.
NRC:	.60-.70
Color:	Match existing
Finish:	Match existing

2. Suspended (Concealed Spline) Installation

Style:	Match existing
Size:	Match existing
Edge Profile:	Match existing
Color:	Match existing
Finish:	Match existing

3. Suspended (Exposed grid, lay-in) Installation

Style:	Match existing
Size:	Match existing.
Edge Profile:	Match existing.
Color:	Match existing
Finish:	Match existing

2.3 MISCELLANEOUS MATERIALS

A. Tile Adhesive

1. Comply with ASTM D1779 or FS-MMM-A-00150, factory made product recommended by manufacturer, bearing UL label for Class 0-25 flame spread.

B. Primer: In accordance with manufacturer of acoustical tile adhesive, substrate shall be primed with one of the following products prior to application of adhesive to remove any residual which would prevent proper attachment of tile:

1. Chemical Wash

2. Sizing

3. Adhesive base or primer

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the building before beginning Work to determine means and methods of construction that will minimize damage to existing acoustical ceiling system

B. Start of Work constitutes acceptance of existing conditions, therefore, contractor is advised to bring any discrepancies to the attention of the Commissioner prior to start of Work.

3.2 PREPARATION

A. Adhesive Tile Installations

1. Before installing adhesively-applied tile on wet-placed substrate, test and verify that moisture level is below tile manufacturer's recommended limits.

2. Surface Preparation: Remove dirt, dust, oil, grease, and other foreign matter that may impair proper bonding of the tile adhesive. Clean and prepare substrate in accordance with the adhesive manufacturer's instructions and as specified.

3.3 INSTALLATION - GENERAL

A. Install materials in accordance with manufacturer's printed instructions and in compliance with ASTM C636, governing regulations, fire resistance rating requirements, as indicated.

1. Coordinate requirements for Work of other trades to be built into ceiling system. Provide supplementary framing as required.

B. On completion, the ceilings shall present a uniform horizontal plane surface, free from blemishes and imperfections.

C. Install panels in coordination with suspension system with suspension members concealed by support of tile units.

D. Neatly scribe and cut panels to fit accurately at borders, interruptions, and penetrations. The cut edges of reveal tegular lay-in mineral fiber panels shall be field cut to match profile of factory edges, in accordance with manufacturer's printed instructions. Paint the cut edges to match factory finish where exposed to view, using paint supplied by panel manufacturer.

3.4 DIRECT (ADHESIVE) TILE INSTALLATION

A. Apply primer as specified herein to surfaces prior to cementing tiles in place.

B. Remove loose dust from backs of tiles by brushing and then priming them with thin coat of adhesive.

C. Cement acoustic tile directly to gypsum board ceiling with (4) spots of adhesive to each square foot of tile. Each spot of adhesive shall produce

a surface of not less than (2) inches in diameter after tile has been pressed in place.

D. Fit adjoining tiles to form neat and uniform hairline joints that are straight and consistent with the adjacent existing ceiling.

E. Scribe and cut tile to fit accurately at ceiling edges and penetrations.

3.5 ADJUSTING AND CLEANING

A. Clean exposed surfaces of ceilings, including trim, edge moldings, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage.

B. Remove and replace Work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

C. Remove and replace Work that is damaged or soiled by this project as directed by Commissioner.

END OF SECTION

SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes surface preparation and field painting of the following:

1. Exposed interior items and surfaces.

B. Paint exposed surfaces as indicated in the paint schedules.

C. When removing or disturbing existing paint on surfaces that have not been tested by the Commissioner for lead content, assume that the existing paint contains lead. Take necessary precautions to protect workers. Provide measures to separate paint removal work areas from occupied areas, and clean-up and dispose appropriately.

1.2 REFERENCES

A. References and industry standards listed in this Section are applicable to the Work. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

1. Federal Specifications (FS)
2. American Society of Testing and Materials (ASTM)
3. N.Y.S. Department of Environmental Conservation
4. U.S. Department of Labor
5. Occupational Safety and Health Administration (OSHA)
6. Steel Structures Painting Council (SSPC)
7. Department of Defense (DOD)

1.3 DEFINITIONS

A. The term "Painting" as used in this Section, means the application of all coatings such as paint, primer, enamel, varnish, shellac, oil, etc. as listed in the Painting Schedules.

B. The term "Painting" also includes preparation of surfaces for such applications, and the clean-up as hereinafter specified.

C. The term "Walls" means all surfaces from floor, or top of base, or top of wainscot, to ceiling or hung ceiling.

1. Include pilasters, breaks, jambs, reveals, returns, arches.

2. Include hardboards, pegboards.

3. Include free standing columns, low partitions.

4. Include masonry, plaster or gypsum board interiors of wardrobes or closets, cupboards and other enclosed spaces.

D. The term "Ceilings" means the general overhead horizontal surfaces.

1. Include cornices, arches, soffits, stair soffits.

2. Include beam and girder haunches.

3. Include primed metal cover and border strips.

4. Include metal frame of ceiling lights and ceiling equipment.

5. Include side faces of hung or furred ceiling.

E. Touching-up bare spots specified for previously primed or painted surfaces is in addition to the coats specified for the paint system.

F. Finishes:

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.

2. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.

3. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.

4. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

G. Concealed: The term "concealed" refers to surfaces, piping, ducts or conduit which cannot be accessed without moving a building element such as within a chase, wall or ceiling.

1. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

a. Furred areas.

b. Ceiling plenums.

c. Duct shafts.

d. Elevator shafts.

H. The term "exposed" refers to any item which is not concealed.

1. The term "exposed to public view" means situated so that it can be seen from eye level from a public location. A public location is that which is accessible to persons not responsible for operation or maintenance of the building.

1.4 SUBMITTALS

A. Product Data

1. Provide manufacturers' product literature for all materials specified and material manufacturer's printed directions and recommendations for environmental conditions, surface preparation, priming, mixing, reduction, spreading rate, application, storage and VOC content, as applicable for each of the materials specified.

B. Samples

1. Initial Selection

a. Submit manufacturer's color charts for each type of finish for approval by the Project Commissioner. Verify colors specified with manufacturers' color charts for availability and notify the Project Commissioner if any discrepancies should occur.

2. Verification prior to installation

   a. Contractor shall furnish color chips for surfaces to be painted.

   b. Submit two samples of each color and finish selected on 12" x 12" hardboard.

   c. Two samples of finish on concrete masonry and metal surfaces.

3. Submit samples of stained and varnished wood in triplicate for approval. Samples shall be 4" x 8" samples of the species of wood, stained and varnished as required and clearly labeled with type of coating, number of coats applied, etc.

4. All samples shall be labeled; and include the following information:

   a. Manufacturer's name

   b. Type of paint/stain/hardener

   c. Manufacturer's stock number

   d. Color: name and number

   e. Federal Specification number, as specified

   f. Federal regulations for amount of lead in paint.

   g. VOC content

C. Quality Assurance

1. Certification that materials for each system are obtained from a single manufacturer.

2. Certification that Work shall be performed by personnel with a minimum of three years' experience who meet the qualifications set forth in OSHA, 29 CFR 1926.62 (Lead In Construction Standard).

3. Certification that material meets or exceeds the performance requirements of Federal Specifications.

4. Certification that materials comply with N.Y.C. and N.Y.S. regulations for Volatile Organic Compounds.

D. Testing

1. Toxicity Characteristic Leaching Procedure (TCLP) testing per Article in Part 3 titled "Disposal of Painted Waste and Debris from Existing Buildings".

E. Guarantee

1. Provide Guarantee per Article 1.08.

1.5 QUALITY ASSURANCE

A. General

1. All painting materials shall arrive at the job ready-mixed.
2. Varnish containers shall not exceed 5 gallon capacity.
3. Remove all rejected materials from the premises immediately.
4. All thinning and tinting materials shall be as recommended by the manufacturer. Generally, all paints shall not require additional thinning.
5. Verify that the specified shop prime paint for each applicable item in this Project is compatible with the total coating system, prior to application.
6. Materials selected for each system type shall be products of a single manufacturer.

B. Qualifications

1. Work of this Section shall be performed by personnel with a minimum of three years' experience in performing this type of Work.
2. The Contractor shall ensure that all employees meet the qualifications set forth in OSHA, 29 CFR 1926.62 (Lead In Construction Standard).

C. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

D. Regulatory Requirements

1. N.Y.C. Building Code, latest edition

2. N.Y.S. Department of Environmental Conservation -Part 205 on "Architectural Surface Coatings" - for (VOC) Volatile Organic Compounds.

3. Steel Structures Painting Council (SSPC).

4. U.S. Department of Labor, Occupational Safety and Health Administration, Construction Industry Standards (29 CFR 1926/1910) Revised 10/1/79, Washington, D.C.

5. Occupational Safety and Health Administration (OSHA) 29 CFR 1926.62 (Lead In Construction Standard).

6. New York State Department of Environmental Conservation regulations, 6 NYCRR part 364.

7. New York City Department of Environmental Protection Waste water disposal permitting requirements.

E. Certifications: Federal Specifications: When materials are specified to comply with Federal Specifications, products will be accepted which meet or exceed the performance requirements of such Federal Specifications and comply with all regulations currently in effect.

1. Indicate that material complies with Federal Specifications by including the Federal Specifications number on the container label or on the product literature, or submit a statement with the Product Data stating that material meets or exceeds the performance requirements of the Federal Specifications.

F. Field Samples

1. Provide samples of each color and finish, under local (space) lighting conditions, in a location where each finish is to be applied.

2. Commissioner will request review of first completed room, space or item of each color scheme required by the Commissioner for color, texture and workmanship.

3. First acceptable room, space or item will be used as project standard for each color scheme, or finish.

4. Primer coat is to be inspected and approved in all locations before any subsequent finish coats are applied.

5. Provide complete paint system on wall sample specified in Section 092900 – Gypsum Board Assemblies. Wall field sample shall be selected by the Commissioner. Provide lighting at the time of inspection, equivalent to the lighting to be in place upon project completion. The sample will be inspected by the Commissioner for proper finish. Inspections will occur before and after painting the sample, with the final evaluation occurring after painting.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to the site in original, unopened containers bearing manufacturers name and label containing the following information:

1. Product name or title of material
2. Manufacturer's stock number, batch number, VOC content in grams per liter and date of manufacture.
3. Manufacturer's name
4. Federal Specification number, if applicable.
5. Federal regulations for amount of lead in paint (less the 0.06% lead in non-volatile ingredients)
6. Contents by volume for major pigment and vehicle constitutions
7. Thinning instructions
8. Application instructions
9. Color name and number

B. Storage

1. Commissioner will designate space on premises for storage of materials. Contractor shall restrict storage in this area to paint materials and related equipment, and provide the following:

a. Provide one (1) approved chemical dry fire extinguisher equal to 20 lb. CO_2 rating in all assigned rooms or locations where painting materials are stored. Fire extinguisher shall bear the label of the National Board of Fire Underwriters and tag of most recent inspection.

b. Provide three (3) standard size red fire pails with clean sand in above locations. At the completion of project, fire extinguishers and pails shall become property of Contractor.

2. Maintain storage area in clean condition, store materials not in use in tightly covered containers. Remove oily rags, waste and empty containers from site each night.

3. Provide Building Engineer with one key for each space if spaces are to be kept locked when not in use.

4. Protect all materials from freezing.

1.7 PROJECT CONDITIONS

A. Environmental Requirements

1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.

2. Do not apply finish in areas where dust is being generated or will be generated while the material is drying.

3. Provide paint and coating products to comply with applicable environmental regulations, VOC requirements and local authorities.

4. In all areas, spaces and rooms being painted, the Contractor shall ensure that there is adequate ventilation to ensure proper paint drying, along with minimizing paint odors.

5. The Contractor shall ensure that all requirements of OSHA 29 CFR 1926.62 (Lead in Construction Standard) are adhered to during the project. In addition, the Contractor shall ensure that proper work area protection and clean-up procedures (as described in this Section) are strictly adhered to during all phases on the project.

1.8 GUARANTEES

A. Adherence of workmanship and materials to Specifications requirements shall be maintained for the one year Contract guarantee period. These requirements shall include the following:

1. There shall be no evidence of blistering, peeling, crazing, alligatoring, streaking, staining, or chalking.

2. Dirt shall be removed without blemishing the finish by washing with mild soap and water.

3. Colors of surfaces shall remain free from serious fading; the variation, if any, shall be uniform.

B. Correct all defects, appearing within the guarantee period, by removal of the defective work and replacement as directed.

C. All corrective measures shall be the Contractor's responsibility, and shall be made at no extra cost to the City of New York. The requirements set forth in Part 3 of these Specifications shall be strictly adhered to.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specified requirements, provide "First Line" or "Top Quality" products of one of the following manufacturers:

1. Benjamin Moore and Co.

2. Devoe and Reynolds Co.

3. Glidden Coatings and Resins.

4. PPG Industries, Pittsburgh Paints Inc.

5. Pratt and Lambert

6. The Sherwin-Williams Co.

7. Tnemec Company, Inc.

8. MAB Paints

9. Carboline

10. Mercury Paint Corp.

2.2 MATERIALS

A. Provide products which meet all N.Y.S. Part 205-VOC requirements for applications outlined herein.

B. Provide products which meet all Federal regulations for amount of lead in paint (less than 0.06% lead in non-volatile ingredients).

C. Provide best quality grade of various types of coatings as regularly manufactured by the paint materials manufacturers. Materials not displaying manufacturers' identification as a standard, best-grade product will not be acceptable.

D. Use only thinners approved by paint manufacturers for applications intended and use only within recommended limits.

2.3 REFERENCE STANDARDS

A. Paint materials shall meet or exceed the requirements of the following standards:

Federal Specifications

1. Primers, Sealers, Undercoats

   a. Metal Primer for Galvanized surfaces: FS TT-P-001984, FS TT-P-650-C

   b. Metal Primer Aluminum or Steel surfaces: FS TT-P-57B

   c. Primer Sealer, Latex Base: FS TT-P-650C

   d. Alkyd Primer (Corrosion Inhibiting) Lead and Chromate Free, VOC Complying: FS TT-P664C

   e. Acrylic Primer: TT-P-650-C

   f. Wood Primer, Exterior: FS TT-P-25

2. Finish Paints

   a. Exterior Alkyd Modified Paint; Gloss: FS TT-P-102E, Type II and Type III

   b. Exterior Acrylic Latex Paint; Flat: FS TT-P-19

   c. Gloss Acrylic Latex Enamel: FS TT-P-1511-B

   d. Flat Vinyl Acrylic Latex Interior: TT-P-29J

   e. Semi-Gloss Vinyl Acrylic Latex Enamel, Interior: TT-P-1511-B

   f. Alkyd Odorless Semi-Gloss Enamel: FS TT-E-529:
   FS TT-E-509C for white and tints; Class A for deep colors.

   g. Aluminum Paint (Ready Mixed): FS TT-P-38D.

h. Heat Resistant Semi-Gloss Enamel: (400°F max. surface temperature): FS TT-E-496

i. Asphalt Varnish: FS TT-V-51

j. Smokestack Black Paint: FS TT-E-496

3. Transparent and Semi Transparent Finishing Systems

a. Spar Varnish: FS TT-V-121, Water Resisting

b. Spar Varnish: FS TT-V-119, Phenolic Resin

c. Stain; Interior Oil Type: FS TT-S-711

d. Polyurethane Coating (Satin Finish): FS TT-C-001951

e. Gloss Varnish

4. Lettering Enamel: Interior/Exterior full gloss enamel: FS TT-E-489

5. Miscellaneous Materials:

a. Mineral Spirits (Petroleum Paint Thinner): FS TT-T-291

b. Color Pigments: Pure, non-fading, finely ground pigments, at least 99 percent passing a 325 mesh sieve. Color pigments that are to be used on masonry, concrete and plaster shall be lime proof: FS-TT-P-381.

c. Putty: Linseed-Oil type for Wood Sash Glazing: FS-TT-P-791B.

d. Shellac: Two pound cut shellac: FS TT-S-300

e. Paste Wood Filler: FS TT-F-336

f. Plastic Wood Filler: FS TT-F-340C.

g. Surface Sealer: Pigmented Oil for Plaster & Wallboard: FS-TT-S-179.

h. Linseed Oil: (Boiled) FS A-A-371A

i. Linseed Oil: aw) FS A-A-379A

j. Lacquer (Brushing) Clear and Pigmented: FS-TT-L-26C.

k. Lacquer, Rubbing, Clear: FS-TT-L-57C

l. Lacquer, Spraying Clear and Pigmented for Interior and Exterior Use: FS-TT-L-58E.

B. Miscellaneous Standards and Requirements

1. Turpentine: ASTM D13.

2. Cold Galvanizing Compound: Single component material conforming to ASTM A780 giving 96% pure zinc in the dried film.

3. Cleaning Solvents: Low toxicity; flash point in excess of 100°F.

4. Spackling Compound: ASTM C475.

5. Polyester Filler: Polyester resin base autobody filler standard weight or finishing grade required by conditions; Marson's "White Lightning" and "Topcoat."

2.4 COLORS

A. Selection

1. Paint colors, surface treatments and finishes will be selected to match existing.

2.5 PAINTING SCHEDULE

A. All previously painted surfaces that are affected as a result of the construction shall be spot primed as needed and receive a minimum of (2) finish coats to match the existing finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions

1. Do not apply painter's finish in any locations until the Work of other Contractors that might damage the new finish is completed.

2. Notify the Commissioner in writing regarding Work by others that does not provide a suitable surface for the new finish.

3. In case of dispute regarding the suitability of any surface, the Commissioner's decision shall be final and conclusive upon all concerned.

4. Contractor shall check the compatibility of previously painted surface with the new coating by applying a test panel 4 foot wide x wall height. Allow test panel to dry thoroughly; verify proper adhesion before proceeding with painting Work.

3.2 PREPARATION AND APPLICATION - EXISTING BUILDING

A. Protection

1. In cases where the painting of surfaces involves removal or disturbance of existing paint and the paint is known or assumed to be lead-based paint, the following protection requirements shall apply:

a. All objects near or adjacent to the surface(s) to be painted shall be moved a minimum of three feet away from that surface(s). Any immovable object, and the floor, within the three foot "work area" shall be covered with one layer of 6-mil polyethylene, sealed on all edges to prevent the penetration of dust and debris. If the ceiling is to be painted, all objects in the room and the floor of the room shall be covered in this manner.

b. All objects bordering the three-foot work area shall be completely covered with clean cloths, heavy building paper or clean plastic covering.

c. If, during the removal of existing paint, the Contractor notices paint chips or other debris related to the ongoing work on objects beyond the border of the three foot work area, these objects shall be cleaned by HEPA vacuuming and wet-wiping and then covered as described in (b) above.

d. The protection shall remain in place during all paint removal activities.

e. All protection is to be carefully removed, cleaned or discarded after painting is complete.

2. In cases where the painting of surfaces does not involve the removal or disturbance of existing paint or the paint is not lead-based as determined by testing by the Commissioner, the following protection requirements shall apply:

a. In each area to be painted, cover and protect furniture, equipment and floors from damage with clean cloths, heavy building paper or clean plastic covering secured in place. All protection is to be carefully removed, cleaned or discarded after painting is complete.

3. Remove and paint previously painted surfaces affected by this project that are behind pictures, signs, furniture, cabinets and similar items that are not secured to walls.

4. Carefully mark removed work for identification and replace in the original location unless otherwise directed.

B. Surface Preparation

1. Gently wet mist the surface to be scraped with water, then remove all loose paint with scraper and putty knife.

2. Sand existing surfaces to dull sheen and gloss. Before sanding, wet mist the area to be sanded. (Power sanding without a HEPA-filtered vacuum recovery system is not allowed).

3. Remove dust by washing with water, using damp sponge or cloth.

4. After washing, spot prime grease and water stains; magic markers marks, crayon marks, lipstick marks, etc; with a quick-drying alcohol base primer sealer to prevent bleeding.

5. Fill all cracks and holes with appropriate filler material, wet mist and sand flush with adjacent surfaces and spot prime. (Power sanding without a HEPA-filtered vacuum recovery system is not allowed).

6. Existing paint that was not removed with scraper and which appears to be sound shall receive spackling compound around perimeter high spots and feathered out so that surface is smooth. Repair gouges created by the scraping process and other imperfections in the existing surface with spackling compound to provide a smooth, even finished surface.

7. Apply number of finish coats specified herein or as many as may be necessary to obtain the proper finish and completely cover the substrate.

8. Cement Plaster: Coat surfaces to be patched with an approved bonding agent. Patch with an approved mortar patching mix and finish to match texture of adjacent surfaces.

9. Existing Woodwork:

   a. Prepare surfaces as indicated in Art. 3.2, B., Subparagraphs 1., 2., 3., 4., above.

   b. Puttying: Fill cracks, open joints, nail holes and similar defects in existing woodwork specified to be painted or varnished with putty or plastic filler. Putty stop nail holes in all new woodwork specified to be painted or stained and varnished. Prime or seal all surfaces in contact with new putty. Color interior putty to match the finish.

   c. Touch-Up

      1) Spot prime defects in existing Work and Work primed under other Paragraphs of Work as necessary to produce an even plane in the new finish.

      2) All worn, scaled, blistered, crackled and discolored places in the existing stained and varnished work specified to be revarnished shall be wet-misted prior to being scraped or sanded, then filled and touched up with stain as required to equalize the color. (Power sanding without a HEPA-filtered vacuum recovery system is not allowed).

      3) Touch-up and equalize the color of new woodwork specified to be stained and varnished where damaged, due to job fitting and trimming.

      4) Touch-up all pitch streaks and knots in woodwork with shellac.

3.3 APPLICATION

A. General

1. No Work shall be performed where cement or plaster is being applied or is in the process of drying.

2. No Work shall be performed in spaces that are not broom clean and free of dust and waste.

3. Apply paint materials to produce smooth finished surfaces, free of brush or roller marks, drops, runs, or sags.

4. Paint materials shall be kept at a proper and uniform consistency.

5. Thin only when necessary to achieve best results.

6. Thinners shall be material recommended by manufacturer of paint, and in quantity as recommended.

7. Excessive use of thinner as indicated by variation in absorption, lack of "hide", thickness of dry film, mottled or streaky coat, shall be cause for rejection. Correct as directed.

8. Thinning of varnish or aluminum paint prohibited.

9. Apply all coats with brush or roller, varying slightly the color of succeeding coats. Spraying will not be permitted.

    a. If recommended by manufacturer, 100% acrylic resin concrete block filler may be spray applied and shall be backrolled as necessary to work material into substrate surface.

10. Brush out or roll on first or prime coat; work well into surface.

11. Each coat shall be inspected, approved and dry before proceeding with additional coats.

12. Allow at least 48 hrs for enamels and exterior oil paint to dry.

13. The surfaces of interior woods and metals shall be sanded or rubbed between coats to assure smooth finish and proper adhesion of subsequent coats.

14. Avoid lapping of paint on glass, hardware, or other adjoining surfaces.

15. Apply no paint to operating units where sliding contact of metals is necessary for proper functioning of unit.

16. Painting is not required on walls or ceilings in concealed and inaccessible areas.

17. Moving parts of operating units will not require finish painting unless otherwise required.

18. Do not paint over any code-required labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plate.

19. Finish doors on tops, bottoms and side edges same as exterior faces.

3.4 FIELD QUALITY CONTROL

A. The Commissioner reserves the right to require the following material testing procedures at any time, and any number of times during period of field painting:

1. Measurement of dry film thickness (DFT) by use of a dry film thickness gauge in accordance with use and calibration requirements of Structural Steel Painting Council [SSPC], "Method of Measurement of Dry Paint Thickness with Magnetic Gauges".

2. Engage services of an independent testing laboratory, recommended by the Commissioner, to sample paint being used. Samples of materials delivered to construction site will be taken, identified and sealed, and certified in presence of Contractor

3. Testing laboratory will perform appropriate tests for any or all of the following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis.

4. If test results show that material being used does not comply with specified requirements, Contractor shall be directed to stop painting Work, and remove non-complying paint; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

a. If the samples do not comply with requirements of the Specifications, costs of testing and remediation of rejected work shall be borne by Contractor.

b. If the tests find that the samples do comply with the requirements of the Specifications, the cost of the testing will be borne by the Commissioner.

3.5 CLEANING

A. General: Contractor shall clean-up behind each paint crew such that painting and clean-up will be a continuous uninterrupted operation. The practice of one general clean-up after completion of all painting will be strictly prohibited. This clean-up will include, but not be limited to the following:

1. Remove spots or defacement resulting from Work of this Section.
2. Retouch all damaged surfaces to leave Work in perfect finished condition.
3. If spots or defacement cannot be satisfactorily removed and retouched, re-finish the surfaces as directed.
4. Within the three foot work area created for removal and painting where existing paint is known or assumed to be lead-based all objects and surfaces shall be thoroughly HEPA vacuumed, wet-cleaned and HEPA vacuumed again. In rooms where the ceiling has been painted all surfaces and objects in the room shall be cleaned in this manner.
5. The contractor shall ensure that the objects and surfaces under protective covering are free of any dust or debris created during painting activities. If necessary, these objects and surfaces shall be wet cleaned and HEPA vacuumed.
6. The contractor shall conduct any cleaning deemed necessary by the independent environmental consultant.
7. Free all operating units of painted materials and leave them clean and in proper working order.
8. Remove from premises all surplus paint materials, debris and any other rubbish resulting from the Work.
9. Leave storage space clean and in condition required for equivalent spaces in project.

3.6 PROTECTION

A. Provide caution tape and/or locked entryways during paint removal activities in existing buildings to prevent access to the work area from unauthorized personnel.

B. Provide "Wet Paint" signs to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their Work after completion of painting operations.

C. At the completion of Work of other trades, touch-up and restore all damaged or defaced painted surfaces as directed by the Commissioner.

3.7 DISPOSAL OF PAINTED WASTE AND DEBRIS FROM EXISTING BUILDINGS

A. Testing

1. Perform Toxicity Characteristic Leaching Procedure (TCLP) testing of all painted waste and debris generated from existing painted objects and surfaces.

B. Storage and Disposal

1. Storage and disposal shall be in accordance with DDC Standard General Conditions specification.

END OF SECTION

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SECTION 23 05 00

GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All work shall be subject to the General Conditions and shall comply with applicable requirements of the Contract.

B. This Section, "230500", governs all requirements as applicable to the mechanical work specified in other Sections of Division 23.

1.2 REFERENCE STANDARDS

A. Compliance with the following codes and standards shall be required as applicable:

1.	AMCA	Air Movement and Control Association
2.	ANSI	American National Standards Institute
3.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
4.	ASME	American Society of Mechanical Engineers
5.	ASTM	American Society for Testing Materials
6.	AWWA	American Water Works Association
7.	EPA	United States Environmental Protection Agency
8.	MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
9.	NEC	National Electrical Code
10.	NEMA	National Electrical Manufacturers Association
11.	NYCBC	New York City Building Code
12.	NYCMC	New York City Mechanical Code
13.	NYSEC	Energy Conservation Construction Code of New York State (New York State Energy Code)
14.	OSHA	Occupational Safety and Health Act
15.	OTCR	Office of Technical Certification and Research (BSA & MEA)
16.	SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
17.	UL	Underwriters' Laboratories, Inc.

B. Conform to materials and equipment rating standards, listings or classifications of the above organizations as well as ratings, listings or classifications accepted under local codes and laws.

1.3 ABBREVIATIONS

A. Meanings of common abbreviations used in text of Division 23 of the Project Specifications are tabulated in ASHRAE Handbook, "Fundamentals", latest edition and listed on drawing M001.00.

1.4 DEFINITIONS

A. "Provide" means furnish and install, complete, the specified material, equipment or other item and perform all required labor to make a finished installation.

B. "Furnish and install" has the same meaning as given above for "Provide."

C. "Furnish" means supply the specified material, equipment or other items.

D. "Install" means provide all labor required to make a finished and complete installation.

E. Refer to General Conditions for other definitions.

1.5 LABOR AND MATERIALS

A. All materials and apparatus required for the work shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces.

B. Contractor shall remove all materials delivered, or work erected, which does not comply with Contract Drawings and Specifications, and replace with proper materials, or correct such work as directed, at no additional cost to the City of New York.

1.6 COVERING OF WORK

A. No pipe, fitting, or other work of any kind shall be covered up or hidden from view before it has been examined or approved by the Commissioner, and/or other Authority Having Jurisdiction over same. Any unacceptable work, or unauthorized or disapproved materials discovered shall be removed and corrected immediately.

B. Any type of equipment shown or specified to be installed outdoors, on grade, on roof or similar areas shall have appropriate protection against outdoor weather. Equipment such as motors, panels, etc. shall have rain hood or appropriate protection as provided under Division 23. Insulated pipes shall have aluminum covers or as specified. Insulated ducts shall be provided with aluminum jacket with overlapping, sealed joints. Uninsulated ducts shall be soldered joints and seams or as specified. Where no protection is feasible, such as in exposed vibration springs, hangers, pipe or steel members, such items shall be rated by the manufacturer for outdoor use or as approved by the Commissioner.

1.7 PROTECTION

A. Contractor shall protect the work and material of all trades from damage by his work or workmen, and shall replace all damaged material with new.

B. Contractor shall be responsible for work and equipment until his work is finally inspected, tested, and accepted; he shall protect his work against theft, injury or damage; and carefully store material and equipment received on site which is not immediately installed; close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

C. Contractor shall be responsible for the preservation of all public and private property, along and adjacent to the work, and shall use every precaution necessary to prevent damage or injury thereto. He shall use suitable precautions to prevent damage to pipes, conduits and other underground structures or utilities, and shall carefully protect from disturbance or damage all property marks until an authorized agent has witnessed or otherwise referenced their location, and shall not remove them until directed.

D. All mechanical and electrical equipment delivered to the site shall have appropriate wrapping to protect them from rain, flood, wind, construction debris and all types of water damage normally encountered at the construction sites. Protection of equipment such as fans, coils, valves and similar equipment shall be the responsibility of the Contractor.

1.8 CUTTING AND PATCHING

A. Provide all cutting and rough patching required for systems and equipment included in these specifications.

B. Provide all sleeves and inserts required before the floors and walls are built; Contractor shall pay the cost of cutting and patching required for pipes where sleeves and inserts were not installed in time, or where incorrectly located. Provide all drilling required for the installation of hangers.

C. All holes cut through concrete slabs or arches shall be punched or drilled from the underside. No structural members shall be cut without the written approval of the Commissioner and all such cutting shall be done in a manner directed by him.

D. Contractor shall not do any cutting that may impair strength of building construction. No holes, except for small screws, may be drilled in beams

or other structural members without obtaining prior approval. All work shall be done in a neat manner by mechanics skilled in their trades and as approved.

E. Provide sleeves and fire stopping at piping and ductwork floor, wall and roof penetrations in accordance with recognized standards.

1.9 SUBMITTALS

A. Procedure:

1. Prepare a schedule of specific submissions at the outset of the Project for the Commissioner's review and approval; make submissions listed below and in the other Sections of Division 23 of the Project Specifications.

a. If submissions listed in other Sections of Division 23 are more specific than those listed below, comply with the more specific requirements.

b. Failure of the Contractor to submit Shop Drawings in ample time for checking shall not entitle him to an extension of Contract time, and no claim for extension by reason of such default will be allowed.

c. Piecemeal submittals are unacceptable and will not be reviewed. No submittal shall be considered for review, the review of which is contingent upon acceptance of other features for which submittals have not been submitted.

d. Submittals from Vendor without Contractor's review and approval stamp will not be reviewed.

e. Submittals shall not be used by the Contractor as a means to secure approval of a substitution. Contractor must indicate all deviations, omissions and substitutions in his submittal; if there are none of these 3 exceptions, he shall then state on the submittal: "NO EXCEPTION TAKEN" and it will be assumed to fully comply with the contract documents. Any submittal without stated exceptions, or without statement that no exception is taken will not be reviewed and will be rejected and returned to Contractor for rectification.

f. All products of a similar nature (i.e., diffusers, air handling units or variable speed drives) shall be provided by a single manufacturer.

B. Shop Drawings:

1. Manufacturer's Drawings:

a. Submit equipment listed in all applicable Sections - include material specifications, operating characteristics and finishes, specified agency listings or approvals.

b. Cuts, brochures or other literature submitted for expeditious approval but incomplete or missing items of hardware or software (performance data) shall be re-submitted until all system or equipment components have been reviewed and approved. Any item not included in the original or first submission shall be considered outstanding work until such item of equipment or work has been submitted or installed in place exactly conforming to the intent of the contract documents.

c. Contractor shall provide preliminary layout drawings of all major pieces of equipment, confirming that the submitted product physically fits within the architectural enclosures. This drawing is required along with the manufacturer's product data.

d. Contractors shall be responsible for all costs related to substitutions as they affect other contractors.

2. Installation Drawings:

a. Furnish coordinated drawings of equipment installation, including interconnecting piping and ductwork. Minimum scale for these drawings shall be 3/8 inch equals one foot.

b. Coordinate space requirements for electrical, plumbing and other trades in the vicinity of work.

c. Include connections, anchorages and fastenings for piping, conduit and ductwork.

d. Make allowance for clearances for access to and maintenance of equipment.

e. Do not install any piping conduits or ductwork, in any area, prior to obtaining approval of its layout by means of submitting shop drawings.

f. Any missing items of equipment, material or labor, during initial submission of shop drawings, are to be completed and

re-submitted for final approval. Shop drawing should not be used as a vehicle for obtaining variances, deviation or omission from the scope of contract documents. Approval of a submittal shall pertain to the portions that conform to the intent of the contract documents.

g. Submission of any missing, incomplete or otherwise deviant layout is subject to re-submission until all contract requirements have been properly included or shown on the same layout.

h. Submit drawings indicated on equipment, piping and ductwork loads to Commissioner for review.

C. Required Samples:

1. Color samples, for prefinished items.
2. Natural finish metals, for quality of finish.
3. As requested in other sections of Division 23.
4. Space sensors.

D. Reports:

1. Compliance with listings and approvals for equipment and for fire ratings.
2. Acceptance certificates from inspecting agencies.
3. Complete printed and illustrated operating instructions where required in report format.
4. Manufacturer's pressure tests on vessels.
5. Manufacturer's performance tests on operating equipment.
6. Field pipe testing reports.
7. Welder's certificates and field test reports.
8. Field operating test results for operating equipment.
9. Performance report on the balancing of air and water systems.
10. Performance reports for vibration isolation equipment.
11. Manufacturer's reports on motorized equipment alignment and installation.
12. Additional reports as noted in other sections.

E. Specific references to any article, device, product or material, fixture or item of equipment by name, make or catalog number shall be interpreted as establishing a basis of cost and a standard quality. All devices shall be of the make and type listed by Special Agencies, such as the Underwriters' Laboratories, and where required, approved by the authority having jurisdiction.

F. Contractor shall be responsible for any deviations in equipment size, motor horsepower and access requirement, from specified products, including coordination with and costs associated with the related work of other Trades.

1.10 COORDINATION

A. Contractor shall prepare preliminary shop drawings suitable for use in coordinating his work with the work of other trades. The HVAC Section shall prepare and furnish background with ductwork at 3/8" = 1'-0" scale for all trades to indicate piping, cable tray and conduit in relation to all structural elements of the construction, including floor elevations; steel locations, size and elevations; partitions locations; door locations and direction of swing; and all other information required to assure coordination of the electrical, sheetmetal and piping trades and fire protection in relation to the Architectural function of the project. Coordination meetings shall be held under the supervision of the Construction Manager (CM) or General Contractor (GC). Each trade shall have proper representation at all coordination meetings for the purpose of detailing, on the drawings mentioned above, the exact location and routing of their work. After the conclusion of the coordination at the working meetings, each trade shall sign the coordinated originals, copies of which shall be distributed by the CM or GC to all parties concerned including the Commissioner. Final shop drawings of all trades shall be in accordance with the coordinated drawing, after which final shop drawings shall be submitted for final approval.

B. If the trade contractor installs work so as to cause interference with work of other trades, he shall make necessary changes in work to correct the condition immediately without delaying project and without extra charge.

C. Dimensional layout plans of equipment rooms shall be made showing all bases, pads and inertia blocks required for mechanical equipment. Include dimensions of bases, bolt layouts, details, etc.

D. Contractor shall furnish all necessary templates, patterns, etc., for installing work and for purpose of making adjoining work conform, furnish setting plans and shop details to other trades as required.

1.11 EXCAVATION AND BACKFILLING

A. Excavation and backfilling of trenches required for the installation of all services underground piping and underground tanks inside and outside of the building are to be provided by each respective Section involved.

B. Trenching: Excavate to required depth and grade, the bottom of trenches to secure required slope for pipe lines. Each trade will be responsible for the required slopes, inverts, bed material, and all other pertinent requirements.

C. Bottom of trench shall be accurately excavated to provide firm, uniform bearing for bottom of the pipe. Pipe having bells, sleeves or other enlargement at joints to have recesses excavated to accommodate these joints.

D. Backfilling: Trenches shall not be backfilled until piping has been tested. Backfill consisting of sand or selected excavated material shall be placed to a level equal to the final grade and hand compacted as required to produce the same density as the soil in the surrounding areas. Furnish and run constantly, if required or directed, sufficient pumping machinery to keep trenches free from water up to the time of inspection and acceptance of that part of this work.

E. Refer to General Conditions for additional requirements governing excavation and backfilling. These requirements shall prevail unless superseded by specific requirements in Division 23.

F. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be approved before work commences. The Contractor shall provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

G. Provide sheet piling where required to properly support sides of trenches and excavations.

1.12 CONCRETE AND GROUTING

A. Requirements for concrete and grouting are specified in other Sections.

1. Concrete shall be 3,000 psi stone concrete with water reducing admixture, except where otherwise specified.

2. Concrete shall have air entraining admixture where exposed to weather.

B. Contractor shall make coordinated layouts showing concrete work required for housekeeping pads, roof curbs, thrust blocks, etc. which are cast in place.

C. Concrete housekeeping pads: 4" minimum thickness, sized to cover the full area of each piece of equipment and access area provided under Concrete Work.

D. Concrete bases: Dimension and height to suit the equipment.

E. Concrete inertia blocks for vibration isolation. Dimensions designed by the vibration isolation equipment manufacturer and inertia block provided by the Contractor.

F. Outside the building all concrete work related to mechanical equipment shall be provided by the Contractor.

1.13 ACOUSTICAL PERFORMANCE OF EQUIPMENT AND SYSTEMS

A. Noise levels from operation of motor driven equipment, whether airborne or structure-borne, and noise levels created by or within air handling equipment and air distribution and control media, are not to exceed the perceived noise levels that existed before the contract work.

B. Acoustical Tests:

1. Commissioner may require contractor to conduct sound tests for the RTU equipment he deems too noisy.

2. The Contractor is required to retest until specified criteria has been met.

1.14 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Instructions and Demonstration for City of New York's Personnel:

1. After all equipment is functioning properly, each system is to be automatically operated for ten (10) working shifts, and not to be adjusted during this period, 80 hours in heating and 80 hours in cooling seasons, and 80 hours during "shoulder" or "swing" seasons scheduled at the convenience of the City of New York. Any adjustments will void the test and start the time period all over again.

2. The hours of operation are to include the City of New York's designated personnel in each shift, for each season.

3. During this period, instruct the City of New York's personnel in the use, operation and maintenance of all equipment of each system. Training will include a lecture-type instruction given in a non-machine room environment. During the lesson, normal operation of the system installed and operating will be explained, along with troubleshooting procedures. This will be followed by a field inspection and demonstration of equipment.

4. The above instruction is exclusive of that required of specified equipment manufacturers. If more stringent or longer instruction is indicated for specific equipment or systems, these shall supersede the above requirements.

B. Operating and Maintenance Data:

1. Provide four (4) complete sets of manufacturer's catalogues, instructions, maintenance and repair information and parts lists for operating equipment and devices. Include one (1) CD with a PDF file with all required documentation.

   a. Include performance curves for fans and pumps, factory furnished wiring diagrams and control diagrams, and applicable flow diagrams.

   b. Submit seven sets of instructions for distribution.

2. Data for the equipment actually installed is to be submitted.

3. The data is to be carefully checked for accuracy by comparison with the installed equipment nameplates.

4. Provide a recommended list of spare parts for equipment and list of special, non-standard tools to service equipment.

5. Index and assemble the instructions in durable loose-leaf binders.

6. The completed binders are to be available at the time the equipment installation begins.

7. In addition, follow all requirements of General Conditions.

1.15 RECORD DRAWINGS

A. Provide and maintain a currently up-to-date record set of reproducible prints showing all changes, additions or omissions made during construction. Contractor shall, at his own expense, produce the Record Drawings.

B. Deliver four (4) sets of all as-built drawings and one (1) set of reproducibles of the record drawings to the City of New York before submitting requisition for final payment.

C. Shop Drawings shall be cross-referenced on the mylar copies for this requirement where applicable.

D. Submit AutoCADD, or other as required by City of New York, compatible as-built drawing files.

1.16 WARRANTY

A. The following supplements the GENERAL CONDITIONS for Mechanical Work:

1. Non-durable, expendable items such as replaceable (not cleanable) air filter media are not subject to replacement after the date of acceptance.

2. Warranty time limits for equipment exceeding those indicated in GENERAL CONDITIONS are specified in the applicable Sections of Division 23.

3. In addition, follow all requirements of General Conditions.

PART 2 - PRODUCTS

2.1 IDENTIFICATION MARKINGS

A. Every equipment valve, damper, control, and apparatus installed under this Contract shall be tagged, labeled or stenciled as follows: Tags and labels securely fastened by brass chains, screws or mastic as applicable. Equipment controls numbered according to equipment schedules on Plans. Tags numbered to conform to a directory listing number, location and use. Directories to be mounted under glass in aluminum self-closing frames, 8-1/2" x 11" in size.

1. Apply identification after testing, insulation and field painting are completed.

B. Valve Identification:

1. Provide an identification tag for each valve, including control valves.

2. Differentiate between the different classes of service in the numbering systems; as an example: "CHW-II", "HW-II" or "CW-II".

3. Use 2" brass tags stamped with designation numbers 1" high, filled in with black enamel.

4. Attach tags securely to handles or spindles of valves with heavy brass "S" hooks or brass chains.

5. Provide six copies of valve charts with one of each framed under glass and mounted where directed.

C. Equipment Identification:

1. For each motor starter, controller and similar accessory provide a lamicore nameplate attached with screws or rivets to a fixed part of the equipment in a visible location.

a. Make plates not less than 2" x 1" x 1/8" thick with 1/4" high characters.

b. Designations for equipment tags shall match contract schedules.

D. Refer to Section 230553 for additional requirements.

2.2 PRIME PAINTING

A. All new piping, supports, auxiliary steel and miscellaneous iron within all MER's shall be prime painted.

B. Provide factory finishes, except as noted, to match Commissioner's color samples, for items appearing in exposed finished work, and including:

1. Panel Enclosures

C. All damaged factory painted surfaces shall be repaired to match original surface. If, in opinion of the Commissioner, such repairs are unsatisfactory, item in question shall be completely refinished or replaced with new.

2.3 WELDING

A. General:

1. All welding procedures, welders, and welding operators shall be qualified in accordance with the requirements of ASME/ANSI B31.9 and Section IX of the ASME Code, latest editions.

2. Welding procedures shall be reported on ASME Section IX Forms "QW," or its equivalent. Joint preparation sketches (to be included

with the welding procedures) shall show all dimensions including tolerances, for bevel angle, land size, offset and root gap.

3. Contractor shall be responsible for the welding performed by personnel of his organization and shall conduct the required qualification tests and submit results to the City of New York for his review and approval.

4. All welding procedures shall meet requirements of New York City Fire Department Certified Requirements. The filing of MSDS form shall be held in the field office.

5. A copy of the welders and fire watch certificate shall be held in the field office of the sight.

B. Processes:

1. Employ the Manual Shielded Metal-Arc (SMAW) welding process.

2. Double butt welding shall be permitted on all joints accessible from both sides. Where double butt-welding is employed, the first root pass shall be back-chipped.

3. Welding of pressure parts shall be performed with low hydrogen type electrodes. Electrodes of Classifications E6012, E6013, E7014 and E7024 shall not be used.

4. Brazing and Soldering:

a. The Contractor shall prepare applicable "Brazing and Soldering Procedures" forms for approval of the Commissioner.

b. Brazing shall conform to ASME Section IX.

c. Soldering shall conform to the relevant procedures in the manuals of the Copper Development Association.

d. For all refrigeration piping, the mechanics shall be skilled and specially trained in this type of pipe joining.

e. The Commissioner may reject any brazed or soldered joint for lack of penetration or for other applicable grounds. These defective joints shall be redone until satisfactory.

C. Quality of Workmanship - In addition to conformance with the procedural and quality requirements set forth in the applicable Code or material specification, all welding shall meet the following requirements.

1. Butt welds shall have full penetrations and shall be slightly convex with uniform height.

2. Each weld shall be uniform in width and size throughout its full length.

3. Each layer of welding shall be smooth, free of slag, cracks, pinholes, undercut in excess of 1/32" and completely fused to adjacent weld beads and base metal.

4. Cover passes shall be free of coarse ripples, irregular surface, non-uniform bead patterns, high crown, and deep ridges or valleys between heads. The surface smoothness of the finished weld shall be suitable for the proper interpretation of non-destructive examination of the weld.

5. Surfaces of parts to be joined by welding shall be cleaned of all oil, grease, paint, scale and rust with solvent and/or wire brushing.

6. Fillet weld size shall be in accordance with the applicable code or as specified on the drawings with full throat and legs of equal length.

7. Welding filler metal and welding flux shall be properly stored in such a manner as to insure that no damage to the coating or corrosion of weld rod will occur. Low hydrogen type electrodes shall be stored in enclosures which provide a regulated temperature as prescribed by the electrode manufacturer. All electrodes shall be properly identified.

8. Socket welds shall have a gap of approximately 1/16" between the bottom of the socket and the end of the pipe prior to welding. Socket welds shall have a minimum of two weld layers.

9. Welds for steam piping shall be X-rayed in accordance with NYCBC requirements. Submit results of X-ray analysis for approval.

D. Repair and Weld Defects:

1. A weld is defective and shall be repaired if it does not meet the acceptance standard of each applicable non-destructive examination as defined ASME/ANSI B31.9, latest edition.

2. Repairs shall be made in accordance with ASME/ANSI B31.9, latest edition.

E. Welding Identification and Weld Marking:

1. All welds must be identified with the welder's identifying symbol. Welds, where more than one welder performs the work, shall be stamped by each welder.

2. Marking shall be done by a permanent method that will not result in sharp discontinuities.

3. Where stamping or marking on the base materials is not practical or feasible, permanently affixed metal bands of the same material may be applied. Stamping or any method of permanent marking on the bands is acceptable.

2.4 EQUIPMENT AND SYSTEMS CRITERIA

A. The criteria of design and performance to produce the required operation is based on equipment shown or scheduled, and as specified.

B. Equipment of other manufacturers will be considered, subject to its acceptability and the following:

1. Changes to the electrical requirements such as circuit breaker or starter size, conduit or wire size shall be coordinated by the Contractor and the expense borne by him with no additional cost to the City of New York.

2. Changes to other trade's scope of work shall be the responsibility of this Contractor, at no extra expense to the City of New York.

C. Equipment and products are specified by names and models and also by performance criteria standards:

1. Where both specifying media are employed, the names and models establish a standard for manufacturing quality, while the performance criteria governs the capacity, rating or output.

2. In any question regarding intent, the capacity, rating or output which is compatible with the other systems, is intended to be of prime concern and is to be provided.

3. Contractor shall follow City of New York Standards for Turn-Over Acceptance, Commissioning and Testing. Where there is a conflict between these requirements and Building Department's requirements, the more stringent requirements shall apply.

D. The descriptions of equipment and systems cover basic equipment and operation, but not all the details of design and construction.

1. The use of singular in descriptions does not limit the quantities to be furnished to produce the complete system, together with the results specified.

2. Furnish equipment required to provide specified performance under installed conditions.

3. Provide accessories required to make complete installation in each instance.

E. Prior to selection and purchase of VFD for the RTU supply and exhaust fan, the Contractor shall engage the VFD manufacturer to evaluate the existing fan system to determine if the potential for VFD-induced mechanical resonance (torsional vibration) of the fan wheel/drive exists. The VFD selection shall be tuned to existing fan system to prevent torsional vibration over the entire range of expected operating speeds.

F. All Mechanical Drawings of Division 23 are schematic and diagrammatic.

1. Symbols and diagrams are used to indicate the various items of work and the complete systems, but they do not necessarily have dimensional significance, neither do they necessarily include all related and subsidiary parts and equipment. Contractor shall provide all parts, elements, etc. as required for a complete and operational system.

2. The work is to be installed complete and ready for operation in conformity with the intent expressed on the Drawings and in the Specifications.

3. Contractor shall provide all transition and connection pieces for piping and ductwork as required for installation of new valves and dampers, etc.

2.5 EQUIPMENT INSTALLATION

A. Locate and set equipment anchor bolts, dowels and aligning devices for equipment requiring them.

1. Level and shim the equipment.

2. RTU fan wheel/drive: Contractor shall perform vibration testing of new motor/drive assembly to ensure that no torsional vibration exists. After one week of continuous operation, the technician will

return to check and realign all shafts, bearings, seals, couplings and belt drives as needed. Provide report indicating completion of this work.

B. Field assembly, installation and alignment of equipment is to be done under field supervision provided by the manufacturer or with inspection, adjustments and approval by the manufacturer, as a part of the Contract.

C. Alignment and Lubrication Certification for Motor Driven Apparatus:

1. After permanent installation has been made and connections have been completed, but before the equipment is continuously operated, a qualified representative of the manufacturer is to inspect the installation and shall report in writing on the manufacturer's letterhead as follows:

a. That shafts, bearings, seals, couplings, and belt drives are perfectly aligned and doweled so the equipment will remain perfectly aligned in the normal service intended by the Documents and that no strain or distortion will occur in normal service. All dowels shall be aligned after equipment is running.

b. That all parts of the apparatus are properly lubricated for operation.

c. That the installation is in accordance with manufacturer's instructions.

d. That suitable maintenance and operating instructions have been provided for the City of New York use.

D. Belt Drives:

1. V-belt drives shall include a driving and driven sheave grooved for belts of trapezoidal cross-section. Belts shall be constructed of fabric and rubber so designed as not to touch the bottom of the grooves, the power being transmitted by the contact between the belts and V-shape groove sides. Drives shall be designed for a minimum of 150 percent of motor horsepower. Drive sheaves shall be of the companion type.

2. All motors shall be provided with fixed sheaves, once the correct speed is determined during testing/balancing period.

3. All fans shall be installed with fixed pitch sheaves on their drive motors. Sheaves shall be selected to provide air quantities under

specified conditions. Air systems shall be put into operation, and Contractor shall determine actual size of sheaves required to produce specified air quantities on installed systems via the use of adjustable sheaves. Adjustable pitch sheaves shall then be replaced with the proper size fixed sheave. Adjustable pitch sheaves shall be property of Contractor and removed from premises.

E. Equipment Turn-Over:

1. Contractor shall follow City of New York Standards for Turn-Over Acceptance, Commissioning and Testing. Where there is a conflict between these requirements and the regulations by commissioning agent, the more stringent requirements shall apply.

2.6 CLEANING AND ADJUSTING

A. Notification:

1. Inform City of New York and Commissioner's field representatives of all cleaning, blowing out and fill-up schedules one week prior to starting.

2. Notify City of New York and Commissioner again, 48-hours prior to each event. If neither attends the procedures, notify in writing, the specific task performed 24-hours after each event.

3. Leaks appearing during the various pressure tests shall be corrected by replacing all defective materials or welds and subsequent tests shall not be made until the piping is found in perfect condition. Caulking of screwed joints or peaning of welds is prohibited. Wherever it is necessary to cut out a weld and the ends of the pipe cannot be conveniently brought together, then a short piece shall be fitted in and welded.

4. Damage to the building and equipment resulting from tests shall be repaired at no additional cost to the City of New York.

5. Tests claimed to have been performed without following above procedures shall be deemed as not performed.

B. Cleaning:

1. Clean all materials and equipment; leave in condition ready to operate and ready to receive succeeding finishes where required.

2. Clean concealed and unoccupied areas such as plenums, pipe and duct spaces and equipment rooms to be free of rubbish and dust generated by the contract work.

3. After completion of all pressure tests, properly clean every piece of apparatus furnished and remove caps and other provisions made for testing purposes only.

C. Adjusting:

1. Adjust and align equipment interconnected with couplings or belts. After one week of continuous operation, the technician will return to check and realign all shafts, bearings, seals, couplings and belt drives as needed. Provide report indicating completion of this work.

2. Adjust valves of all types and calibrate equipment of all types to provide proper operation.

3. Applicable motors and fans shall be properly oiled and left ready for operation.

4. Verify that each and every supply and return and exhaust fan, each fan coil unit fan, motor and automatic control valve is in running condition. All equipment shall be inspected by the Commissioner.

5. Submission of certified tests shall, in no way, relieve the Contractor of fulfillment of guarantee.

6. Gauges, instruments, thermometers and meters shall be checked and tested to specified accuracy.

7. Alarms shall be tested to fulfill satisfactory operating conditions.

8. Allow sufficient time to perform all tests, adjustments, etc., necessary to place the various systems in final operating condition, verify performance requirements and check all safety devices. Labor, instruments, etc., required for various tests shall be furnished by Contractor. The Contractor shall see that all his Sub-Contractors, manufacturer's representatives or Field Engineers necessary to check and adjust various systems are present, with sufficient forms, and that all test results are recorded properly and turned over to Commissioner for approval.

9. The Commissioner will make final check for all systems only after Contractor has completed and returned to the Commissioner all recorded test data together with letter that his work is 100%

complete. Additional tests may be required to meet the requirements of City of New York documents for demonstration of various systems, whether or not specified, to verify performance, workmanship or for adjustments.

10. Unless otherwise specified, equipment shall be installed and adjusted in accordance with manufacturer's recommendations to function properly with capacities required or specified.

11. Provide adjustments during summer, winter and shoulder/swing seasons.

D. Running Test of Piping Systems:

1. Any section of the work, after it has been completed and otherwise satisfactorily tested, shall be put in actual operation by Contractor and operated by him for a period of 2 days of 24 hours each, during which time any defects which may appear shall be remedied and any necessary adjustments shall be made. Test shall be performed in the presence of the City of New York and Commissioner, and serve as part of the Instructions Program.

2. During the time of the tests, repack all valves, make all adjustments and otherwise put the apparatus in perfect condition for operation, and shall instruct the Commissioner in the use of management of the apparatus. All joints shall be made absolutely tight under tests. Caulking of pipe joints or makeshift methods of repairing leaks shall not be allowed. Piping which is not tight under tests shall be taken down and reassembled.

3. All gauges, thermometers, alarms, instruments, etc. shall be tested to demonstrate that they are functioning properly and within the range of these devices, and to show their degree of accuracy.

4. If during the first test run, the system cannot be completely vented within 24 hours, install additional air vents at high points of system to facilitate quick venting of all water systems.

E. Permanent Equipment Operating During Construction:

1. Use only in same service as the permanent applications.

F. Retouch or repaint equipment furnished with factory finish as required to provide same appearance as new.

PART 3 – EXECUTION

3.1 GENERAL

A. Temporary Protection:

1. Provide and maintain protection for the work whether completed or in progress.

2. Provide suitable coverings and enclosures.

B. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging and hoisting services necessary for erection, and/or delivery into the premises, of any equipment and apparatus furnished. Remove from the premises when no longer required.

C. Waterproofing:

1. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be as approved by the Commissioner before work is done. This Contractor shall provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

3.2 ACCESSIBILITY

A. The installation of valves, dampers and other items shall be conveniently and accessibly located with reference to the finished building floors, walls, roof and penthouses as applicable.

3.3 MODIFICATIONS TO EXISTING WORK

A. Contractor shall perform all work as shown or as specified, within the existing site and structures as part of this Contract without detriment to the existing systems or equipment to be kept in operation or maintained in their places.

B. For full extent of modifications to be done to existing systems, Contractor shall inspect existing systems and site conditions to familiarize himself with the complexity of his work related to removals and relocations required, and the existing finishes to be preserved without any damage resulting from possible careless installation procedures. Upon written request by the bidders, City of New York shall make the existing

schematic plans available for inspection (at his own address) without any responsibility for their completeness or accuracy.

C. As-Built drawings are not available on the existing installations. Any drawings that may be available to the Contractor are for information only. All field criteria must be field verified by Contractor.

D. All cutting shall be done only by mechanics skilled in the particular trade which is affected. No cutting shall be done without proper protections against damage, dirt and dust resulting therefrom or without proper safeguards to workmen, the public, and occupants of buildings.

E. Before cutting is started in any location, Contractor shall carefully investigate conditions influencing human and structural safety. Existing piping, wiring and items concealed in walls and slabs, wherever these walls and slabs are removed, shall be properly relocated, rerouted or removed as the case may require.

F. The Contractor shall perform all finish masonry, repairing, restoring and finishing of all cut openings, closing up of existing openings, and removing and restoring the affected sections of the suspended ceilings.

G. If, during normal occupancy of the building, circumstances necessitate temporary shutdown of any facilities or otherwise interfere with access to building, City of New York shall be given a minimum of 48 hours notice before doing such work.

H. In all areas where interface, relocation or alternation work is to be done, Contractor shall disconnect and remove from the premises all existing ductwork, piping, etc., that will not be required to remain in service after the alterations are completed. All such equipment (except as requested as salvage by the City of New York) shall become the property of this Contractor, and he shall remove same from the premises immediately upon disconnection. Existing ductwork, piping, etc., being removed shall not be reused.

I. Contractor shall move or relocate any existing mechanical equipment, piping, ductwork, etc., which may temporarily interfere with the construction, (to a temporary location) if the existing equipment is to be kept in operation during construction. He shall also install temporary piping, ductwork or equipment that might be required for offsetting all piping around the construction area in order to maintain services to the existing systems.

J. The Contractor shall provide all cuts and openings through structural slabs and walls, except for core drillings for passage of piping. Contractor shall

coordinate his work with concrete contractor and provide necessary dimensions for all openings.

K. Upon completion, remove all temporary piping and equipment, shoring, scaffolds, etc., and leave all areas clean and free from material and debris resulting from work performed under this Section. Provide rough patching in areas affected by contract work.

L. Test all piping to be retained or shown to be re-used together with the new extensions connected to them. Install isolation valves and all accessories as required.

M. Where a fan or any of its connected ductwork is to be modified, relocated or ductwork extended to a new discharge location, test fan prior to starting work and submit test data to Commissioner for record purposes. Test same fan following completion of work to verify its final capacity in terms of CFM, Static Pressure and Amperes drawn while in operation, showing compliance to data previously established.

3.4 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof, for purposes other than testing even with the City of New York consent, shall not be construed to be an acceptance of the work on the part of the City of New York, nor shall it be construed to obligate the City of New York in any way to accept improper work or defective materials.

B. Use of permanent equipment for temporary services must be approved in writing by the Commissioner.

3.5 CODES, RULES, PERMITS & FEES

A. The Contractor shall give all necessary notices, obtain all permits and filings including, but not limited to, New York City DEP, New York State DEC, New York City and State Building Code requirements, and pay all government sales taxes, fees, and other costs, in connection with his work. However, all utility connections, extensions, and tap fees for water, storm, sewer, gas, telephone, and electricity shall be paid directly to utility companies and/or agencies by the City of New York, unless otherwise indicated. The Contractor shall file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Commissioner before request for acceptance and final payment for the work.

B. The complete design and construction shall conform to the requirements of the NYCBC, NYCMC, NYCFC, NYSEC, NFPA, NEC, FM, UL and any other local or state code which may govern.

C. Provide all New York City and New York State permits for boilers, stacks, chillers, fuel oil equipment, fuel oil tanks, equipment, systems, etc. as required.

3.6 FINAL INSPECTION

A. Contractor shall arrange and schedule final inspection of work and shall notify the Commissioner in writing that the Contractor has thoroughly checked his work and, in the opinion of the Contractor, is ready for final inspection.

B. During the entire period schedule for these inspections, the Contractor and representatives of each manufacturer of equipment involved shall be present. All of these organizations shall have sufficient and competent personnel present so that adjustments can be made to all systems without delay.

C. Contractor shall recheck equipment after seasonal use to ensure proper operation for summer, winter and shoulder/swing seasons.

3.7 ACCEPTANCE

A. The operation or the temporary use of the equipment and the mechanical and electrical installation, by the City of New York does not constitute an acceptance of the work. The final acceptance is to be made after the Contractor has adjusted his equipment, demonstrated that it fulfills the requirements of the Contract Documents, and has furnished all the required Certificates. Warranties and guaranties are effective after the final acceptance.

END OF SECTION

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SECTION 23 05 01

SCOPE OF HVAC WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All work shall be subject to the General Conditions and shall comply with applicable requirements of the Contract.

B. Requirements of Section 230500 shall also govern work specified herein, together with all applicable paragraphs of Mechanical sections.

PART 2 - SCOPE OF WORK

2.1 WORK INCLUDED

A. This Specification and the accompanying Contract Drawings are intended to include the furnishing and installation, in a workman-like and approved manner, of all labor, materials, equipment and appliances necessary and required to completely install the HVAC and Fire Protection Systems as specified and shown on the Drawings.

B. General scope of work shall be as listed below, however, omission of specific items shall not be construed as being omitted from the Contract if the item is mentioned elsewhere or implied.

C. The list is not intended to be complete, but it is to serve as a guide to the character and extent of the work, and in general, shall consist of the following:

1. Complete DDC control and BAS system.

2. All control and interlock wiring (in conduit) for the BAS loop system and all components.

3. All electrical interlock wiring, except as noted otherwise.

4. All miscellaneous appurtenances, accessories and specialties required for a complete installation placed into satisfactory operating condition.

5. Provide identification and signage for new and refurbished equipment.

6. Miscellaneous steam piping, valves, and accessories.

7. Provide new electric damper actuators and/or dampers, new control valves, new air balancing devices, and miscellaneous control accessories.

8. Integrate controls of air-cooled self-contained or split systems into new BMS.

9. Integrate controls for Chillers, cooling towers, chilled water and condenser water system, including pumps, and all subsystems into new BMS.

10. Modify motor starters and provide new variable frequency drives (VFD) for fans and hot water pumps as specified and/or scheduled.

11. Insulation of piping, ductwork, etc.

12. Prime painting of equipment and piping, shop finishes, piping identification, stenciling and color coding.

13. Training, instructions and guarantees.

14. Provide "Air-Side Economizer Systems" including controls.

15. Furnishing of all access doors and panels required in plaster or dry wall ceilings and partitions.

16. Testing, Adjusting, Balancing and Commissioning.

17. Protection during construction.

END OF SECTION

SECTION 23 05 03

PIPES AND TUBES FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Pipe and pipe fittings for the following systems:

1. Heating water piping.
2. Chilled water piping.
3. Low pressure steam piping.
4. Low pressure steam condensate piping.
5. Unions and flanges.

B. Related Sections:

1. Section 23 05 23 - General-Duty Valves for HVAC Piping: Product requirements for valves for placement by this section.
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
3. Section 23 07 00 - HVAC Insulation: Product requirements for piping insulation for placement by this section.
4. Section 23 21 16 - Hydronic Piping Specialties: Product requirements for hydronic piping specialties for placement by this section.
5. Section 23 22 16 - Steam and Condensate Piping Specialties: Product requirements for steam and condensate piping specialties for placement by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.4 - Gray Iron Threaded Fittings.

3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
5. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
6. ASME B31.9 - Building Services Piping.
7. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
8. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
4. ASTM A536 - Standard Specification for Ductile Iron Castings.
5. ASTM B32 - Standard Specification for Solder Metal.
6. ASTM B68 - Standard Specification for Seamless Copper Tube, Bright Annealed.
7. ASTM B68M - Standard Specification for Seamless Copper Tube, Bright Annealed (Metric).
8. ASTM B75 - Standard Specification for Seamless Copper Tube.
9. ASTM B75M - Standard Specification for Seamless Copper Tube (Metric).
10. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
11. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

12. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

13. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

14. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

2. AWS D1.1 - Structural Welding Code - Steel.

D. American Water Works Association:

1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

2. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.

3. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

1.3 SUBMITTALS

A. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes for approval, prior to fabrication or installation.

B. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

C. Welder certifications and welding procedures.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with NYCBC requirements.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.

B. Installer: Company specializing in performing work of this section with minimum ten 10 years documented experience.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 COORDINATION

A. Coordinate installation of buried piping with trenching.

B. Reference Section 230500 for additional requirements.

PART 2 - PRODUCTS

2.1 HEATING WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A53M, Schedule 40 seamless, black.

1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.

2. Joints: Threaded for pipe 2 inch (50 mm) and smaller; welded for pipe 2-1/2 inches (65 mm) and larger.

B. Copper Tubing: ASTM B88 (ASTM B88M), Type L hard drawn for sizes 3" and smaller.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.

2. Joints: Soldered for 125 psig, brazing for operating pressure above 125 psig.

2.2 CHILLED WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A53M, Schedule 40 seamless, black.

1. Fittings: ASME B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.

2. Joints: Threaded for pipe 2 inch (50 mm) and smaller; welded for pipe 2-1/2 inches (65 mm) and larger.

B. Copper Tubing: ASTM B8, Type L, hard drawn for sizes 3" and smaller.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.

2. Joints: Soldering for operating pressure 125 psig or less. Brazing for operating pressure above 125 psig.

2.3 LOW PRESSURE STEAM PIPING, ABOVE GROUND (15 PSIG (103 kPa) MAXIMUM)

A. Steel Pipe: ASTM A53/A53M, Schedule 40 seamless, black.

1. Fittings: ASME B16.3 malleable iron Class 125, or ASTM A234/A234M forged steel Class 125.

2. Joints: Threaded for pipe 2 inch (50 mm) and smaller; welded for pipe 2-1/2 inches (65 mm) and larger.

2.4 LOW PRESSURE STEAM CONDENSATE PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A53M, Schedule 80 seamless, black.

1. Fittings: ASME B16.3 malleable iron Class 125, or ASTM A234/A234M forged steel Class 125.

2. Joints: Threaded for pipe 2 inch (50 mm) and smaller; welded for pipe 2-1/2 inches (65 mm) and larger.

2.5 UNIONS AND FLANGES

A. Unions for Pipe 2 inches (50 mm) and Smaller:

1. Ferrous Piping: Class 250, malleable iron, threaded.

2. Copper Piping: Class 150, bronze unions with brazed joints.

3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches (65 mm) and Larger:

1. Ferrous Piping: Class 150, forged steel, slip-on flanges.

2. Copper Piping: Class 150, slip-on bronze flanges.

3. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene gaskets.

C. Flanges shall be of same weight as the fittings and valves in each service category. Welding neck flanges shall be used with flanged valves, equipment, etc., on welded lines. Galvanized screwed flanges shall be used on galvanized screwed lines. Flanges shall be drilled in conformance with 150 lbs. or 300 lbs. standard and shall be faced and spot-faced. Screwed and loose flanges on brass piping shall be brass. Laps shall be machined on front, back and edge. Screwed flanges shall have faces perpendicular to adjoining pipe.

2.6 PIPE FITTINGS

A. Each pipe fitting shall have cast, stamped, or indelibly marked on it the marker's name or mark, weight, and quality of the product when such marking is required by the approved standard.

B. Welding fittings shall be of same material and schedule as pipe to which they are welded. Welding fittings including laterals shall be approved factory reinforced to develop full working pressure of connecting piping main. Welding elbows shall be long radius pattern. Welding fittings shall be used exclusively, except as otherwise specified. Weldolets may be used for branches only where branch is two (2) or more nominal pipe sizes smaller than main or riser. All welding "lateral" fittings shall have pressure ratings equal to the pipe with which they are to be used. Welding fittings shall be of Tube-Turn or Walworth manufacture or approved equal, to conform to ASTM-A-234 specifications.

C. Nipples shall be extra heavy shoulder type of same material as pipe, close nipples are not acceptable.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 CONNECTIONS

A. Copper with solder or brazing joints shall be cleaned bright and properly fluxed. Flux shall be non-corrosive as approved.

B. Threaded Joints:

1. Make up screw pipe with clean sharp threads and pipe joint cement used on male thread only.

2. Ream ends of pipe and clean out the pipe after cutting.

3. Use graphite paste on threads of cleanout plugs.

4. Provide sufficient number of flanges or unions to disassemble piping without breaking screwed fittings.

C. Teflon paste shall be used on screwed joints and shall be applied to the male thread only.

D. In connection to equipment, the manufacturer's recommendation as to pipe size and arrangement shall be followed. Connection to equipment shall be made to permit ready disconnection of equipment with minimum disturbance to adjoining pipe. Screwed or flanged unions shall be used at all equipment at inlet and outlet ends. Piping shall be flanged, or fitted with unions for all sections immediately adjacent to connection of equipment which may require pipe removal to aid in all large tube pulling, coil removal, cleaning etc.

E. Assembly of the mechanical joint pipe and fittings shall be complete with a torque wrench. Torque to be applied to each bolt shall be between 60

pounds and 90 pounds. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation will not be permitted.

F. Flange joints shall be faced true, packed and made up perfectly square and tight. Each flange joint shall be provided with suitable grade steel bolts for the specific service and with hexagon nuts. Bolts and nuts shall be dipped in a mixture of graphite and oil, just before installation.

G. Gaskets shall have proper thickness and suitable for specific service. All gaskets shall be asbestos free. Gaskets in steam service shall meet the requirement of the utility company.

H. Where piping is to be installed under related work by other Sections, in connection with work and equipment installed by this Trade, the piping will be installed by other Sections, this Trade shall make the final connections.

I. Provide di-electric fittings for all connections between ferrous and non-ferrous metals.

3.3 INSTALLATION - ABOVE GROUND PIPING

A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.

E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 00.

F. Install non-conducting dielectric connections wherever jointing dissimilar metals. Insulate pipe joints or valves between dissimilar metals, to prevent dielectric action; use isolating flanges. Dielectric couplings are unacceptable

G. Cap pipe and equipment outlets during construction; keep lines and inside of equipment free of foreign materials.

1. Provide for expansion without warping lines, or dislocating or straining connected equipment beyond allowable stress limits.

2. Install piping to clear building construction and to avoid interference with other work.

3. Conceal piping.

H. Water Lines:

1. Pitch chilled water and hot water piping upward in direction of flow or install piping with top of pipes at same level, using eccentric reducers.

I. Place valves and specialties so as to permit easy operation and access; pack all valves at the completion of the work before final inspection.

J. Drawings indicate generally the sizes and locations of pipe lines, but the Construction Manager reserves the right to direct changes in run and details of pipe work as necessitated by site conditions. Piping to be of sizes indicated on the Drawings; size any pipe diameter not shown on the Drawings to be in proportion to the load carried at the same resistance as similar piping, or of sizes as directed by Construction Manager.

K. Cut piping accurately to measurements established at the Construction Site and work into place without springing or forcing, properly clearing all openings, structural members and other equipment. Overhead piping to run as high as possible under structural members.

L. Establish invert elevations, slopes for drainage to 1/4 inch minimum. Maintain gradients.

M. Slope piping and arrange systems to drain at low points.

N. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

O. Install valves in accordance with Section 23 05 23.

P. Install hydronic piping specialties in accordance with Section 23 21 16.

Q. Install steam and condensate piping specialties in accordance with Section 23 22 16.

R. Insulate piping. Refer to Section 23 07 00.

S. Install pipe identification in accordance with Section 23 05 53.

3.4 ROUTES AND GRADES

A. Piping shown on the drawings shall be considered as diagrammatic for clearness and may or may not, in all parts, be shown in its true position. This fact does not, in any way, relieve the Contractor from full responsibility for the proper erection of a system of piping in every aspect suitable for the work intended.

B. Drawings indicate generally sizes and locations of pipelines, but the right is reserved to direct changes in details of pipe work as necessitated by actual conditions. Piping shall be of sizes indicated on drawings. Any pipe size not shown shall be in proportion to the load carried at the same resistance as similar piping, or of size as directed.

C. Piping shall be accurately cut to measurement established at the construction site and shall be worked into place without springing or forcing, properly clearing openings, structural members and other equipment. Overhead piping shall be run as high as possible under structural members.

D. Exposed piping shall be run perpendicular and/or parallel to floors, walls, etc. Piping and valves shall be grouped neatly and shall be run so as to avoid reducing headroom or passage clearance.

E. Fittings of the eccentric reducing type shall be used where change of size occurs in horizontal piping for proper drainage or venting.

F. Steel pipe bends shall be made of open hearth, low carbon steel, leaving a smooth uniform exterior and interior finish. Pipe bends shall be made with seamless steel pipe, having a minimum radius of not less than 5 pipe diameters.

G. Long-turn fittings shall be used wherever conditions permit.

H. Piping above grade shall be installed so as to be readily accessible for operation, maintenance, repair or replacement.

I. Extra heavy nipples for short shoulder type only. Close nipples are prohibited.

J. Under all conditions, and unless otherwise shown or directed, branches from any steam main shall be taken from the top of the pipe, and all valve stems shall stand upright or at an angle above the center line of the pipe and not handle down.

K. No piping or work of any kind shall be concealed or covered until all required tests have been satisfactorily completed and the work has been approved by the Engineer and all authorities having jurisdiction.

3.5 INSTALLATION - HEATING AND COOLING PIPING SYSTEMS

A. Install heating water and chilled water piping in accordance with ASME B31.9.

B. Install steam supply and steam condensate return piping in accordance with ASME B31.9.

3.6 FIELD QUALITY CONTROL

A. Test heating water piping system and chilled water piping system in accordance with ASME B31.9.

B. Test low pressure steam supply piping and low pressure steam condensate piping in accordance with ASME B31.9.

3.7 CLEANING

A. After completion, fill, clean, and treat heating water piping system and chilled water piping system.

B. After completion, clean, and treat low pressure steam supply piping and low pressure steam condensate piping.

3.8 PRESSURE TESTING OF PIPING SYSTEMS

A. Pay fees for tests and inspections; furnish labor, materials, equipment and any instruments required for the tests.

B. Perform tests and comply with requirements of the inspecting agency to obtain approval for Owner's use of systems and equipment, as a part of the Contract Work.

C. Replace or repair equipment damaged during testing.

D. Give advance notice of tests to Authorities Having Jurisdiction.

E. Replace any materials which fail under testing and replace or satisfactorily repair any other materials or work damaged by the testing or failures.

F. Do not conceal or insulate any section of piping until testing on that section has been satisfactorily completed and approved.

G. The Contractor shall provide all temporary valves, blanks and accessories for all piping tests, as part of the Work.

H. Test Criteria: Make all piping systems tight under the following test conditions:

1. Perform hydrostatic test as specified in "Examination, Inspection and Testing" of ANSI B31.9 code, except that duration of test shall be two hours without pressure drop and that no system shall be tested at less than indicated in Item 3 below.

2. If outside temperature is expected to be at or below freezing temperature, the Owner has the option to require that the Contractor test piping by the use of non-corrosive glycol/water mixture.

3. Unless otherwise noted or specified, screwed piping shall be tested under a hydrostatic pressure of 200 psig for a period of 2 hours without fall in pressure gauge reading. Welded and brazed piping shall be subjected to 150 psig air pressure test and welds inspected by applying soap suds. During the air pressure tests, pinholes shall be rewelded at the direction of the Engineer. Following the air pressure test, piping shall be subjected to hydrostatic test for a period of 2 hours without fall in the pressure gauge reading.

I. Hydrostatic test at 1-1/2 times operating pressure. Operating pressure of water systems, unless noted otherwise, shall be determined by adding pump shutoff head to building static height, with consistent units.

J. Heat exchangers, valves, strainers and piping accessories shall be treated as part of the piping system for testing purposes, except for the following items:

1. Pressure gauges or other sensitive instruments which might be damaged during testing - remove during test and replace after test.

3.9 SYSTEM REQUIREMENTS

A. All piping systems and components shall be rated for a minimum design working pressure of 150 psig, unless otherwise noted.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes single- and three-phase motors furnished loose to Project.

B. Related Sections:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

2. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. New York City Electrical Code

E. Underwriter's Laboratory

F. New York State Energy Research and Development Authority (NYSERDA)

1.3 SUBMITTALS

A. Product Data: Submit catalog data for each motor furnished. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

B. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

C. The motor nameplate and connection diagram shall be stainless steel and contain the following information:

1. Manufacturers' name
2. Rated volts and full load current
3. Rated frequency and number of phases
4. Rated full load speed
5. Rated temperature rise and rated ambient temperature
6. Time rating
7. Rated horsepower
8. Locked rotor code letter
9. Motors starting on wye connection and running on delta, shall be marked with the code letter corresponding to the wye connection.
10. Dual voltage motors which have a different locked rotor KVA on the two voltages, shall be marked with the code letter for the voltage giving the highest locked rotor KVA.
11. NEMA design letter
12. Service factor

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. All motors shall be UL approved and listed.

1.5 DELIVERY, STORAGE AND HANDLING

A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR MOTORS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Cooper Industries Inc.
2. Baldor Electric Co.
3. General Electric Co.
4. Emerson Electrical

B. Motors 1/2 hp and Larger: Three-phase motor (unless otherwise noted on Drawings) as specified below.

C. Motors Smaller Than 1/2 hp: Single-phase motor (unless otherwise noted on Drawings) as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.

D. Three-Phase Motors: NEMA MG 1, Design B, premium-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.

1. Voltage: 230/460 volts, three phase, 60 Hz or as indicated on Drawings.
2. Service Factor: 1.15 unless indicated otherwise on Drawings.
3. Enclosure: Meet conditions of installation unless specific enclosure is indicated on Drawings or specified. Enclosure for pump motors or motors exposed to weather shall be totally enclosed fan-cooled type.
4. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
5. Insulation System: NEMA Class F.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

7. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.

8. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

9. Sound Power Levels: Conform to NEMA MG 1.

10. Efficiency: Premium efficiency motors conforming to NEMA. Motor efficiencies shall meet the requirements for financial rebates from NYSERDA.

11. Inverter Duty Rated for motors controlled by VFD. Fan motors controlled by VFD shall be equipped with shaft grounding rings.

12. Motor weight exceeding 25 pounds shall have lifting eyes.

13. Motor efficiencies shall meet minimum requirement for local utility company rebates.

E. Single Phase Motors:

1. Permanent split-capacitor type where available, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.

2. Voltage: 115 volts, single phase, 60 Hz.

F. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned motors were indicated on Drawings.

B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing motors to remain or are to be reinstalled.

3.2 INSTALLATION

A. Install motor in alignment with shaft of the drive. Alignment test must be done prior to operating the equipment.

B. Install engraved plastic nameplates in accordance with Section 26 05 53.

C. Ground and bond motors in accordance with Section 26 05 26.

D. Coordinate two-speed motor installation with Division 26.

E. Provide motor shaft grounding ring (SGR) for motors controlled by Variable Frequency Drive.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.15.

END OF SECTION

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SECTION 23 05 14

MOTOR CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All work shall be subject to the General Conditions and shall comply with applicable requirements of the contract.

B. Requirements of Section 230500 shall also govern work specified herein, together with all applicable paragraphs of other Mechanical sections.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.

2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

3. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.

4. NEMA ICS 3 - Industrial Control and Systems: Factory Built Assemblies.

5. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.

6. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.

7. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.

8. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. Underwriters Laboratories Inc.:

1. UL 198E - Class R Fuses.

2. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

3. UL 508 - Industrial Control Panels.

4. UL 845 - Motor Control Centers.

D. Material and Installation shall comply with latest editions of NYCBC Code.

E. Examine the Contract Documents of Division 26 for coordinating work specified under this section.

1.3 SUBMITTALS

A. Submit shop drawings and product data in accordance with general conditions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all motors, and furnish all variable speed drives, combination motor starters/disconnect switches, disconnect switches and starters that are required for controlling the HVAC equipment and motors.

B. Coordinate with Division 26 work for installation of and for proper integration of electrical power wiring with the motors, and equipment that are provided under Division 23.

2.2 VARIABLE FREQUENCY DRIVES

A. Description

1. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.

2. The drive manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFD's that are manufactured by a third party and

"brand labeled" shall not be acceptable. All VFDs installed on this project shall be from the same manufacture.

B. Quality Assurance

1. Referenced Standards:

a. Institute of Electrical and Electronic Engineers (IEEE)

1) Standard 519-1992, IEEE Guide for Harmonic Content and Control.

b. Underwriters laboratories

1) UL508C

c. National Electrical Manufacturer's Association (NEMA)

1) ICS 7.0, AC Adjustable Speed Drives

d. IEC 16800 Parts 1 and 2

e. National Electric Code (NEC)

1) NEC 430.120, Adjustable-Speed Drive Systems

f. International Building Code (IBC)

1) IBC 2006 Seismic – referencing ASC 7-05 and ICC AC-156

2. Qualifications:

a. VFDs and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs with red label UL stickers, requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.

b. CE Mark – The VFD shall conform to the European Union ElectroMagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level.

c. The entire VFD enclosure, including the bypass shall be seismically certified and labeled as such in accordance with the 2006 International Building Code (IBC):

1) VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.

2) Seismic importance factor of 1.5 rating is required, and shall be based upon actual shake test data as defined by ICC AC-156.

3) Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axis of motion.

d. Acceptable Manufacturers

1) ABB ACH Series

2) Yaskawa

3) Johnson controls

4) Siemens BT series (SED2 series not permitted)

5) approved equal

e. The VFD manufacturer shall have available a comprehensive, HVAC Drive Computer Based Training (CBT) product. The CBT product shall include detailed, interactive sections covering VFD unpacking, proper mechanical and electrical installation, and programming. The CBT product shall allow the user to provide just-in-time training to new personnel or refresher training for maintenance and repair personnel on the user's site. The CBT product shall be repeatable, precise and shall include record keeping capability. The CBT product shall record answers to simulations and tests by student ID number. The CBT product must be professionally produced and have interactive sections, student tests, and include video clips of proper wiring and installation.

3. Optimized Selection:

a. Prior to selection and purchase of VFD, VFD manufacturer shall evaluate the existing fan system to determine if the potential for VFD-induced mechanical resonance (torsional

vibration) of the fan wheel/drive exists. VFD shall be tuned to existing fan system to prevent torsional vibration over the entire range of expected operating speeds.

C. Submittals

1. Submittals shall include the following information:

a. Outline dimensions, conduit entry locations and weight.

b. Customer connection and power wiring diagrams.

c. Complete technical product description include a complete list of options provided. Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification.

d. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

1) The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors, no exceptions.

D. The VFD package as specified herein shall be enclosed in a UL Listed Type enclosure, exceeding NEMA-4X enclosure design criteria completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

1. Environmental operating conditions: VFDs shall be capable of continuous operation at -18°C to 50°C (0 to 122°F) ambient temperature as per VFD manufacturers documented/submittal data or VFD must be oversized to meet these temperature requirements. Not acceptable are VFD's that can only operate at 40°C intermittently (average during a 24 hour period) and therefore must be oversized. Altitude 0 to 3300 feet above sea level, less

than 95% humidity, non-condensing. All circuit boards shall have conformal coating.

2. Provide thermostatically controlled cooling fans and silicone element space heaters.

E. All VFDs shall have the following standard features:

1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

2. The VFD shall have code-required disconnecting means.

3. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.

4. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output Form-C relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

5. The VFD's shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.

6. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without

requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, the VFD shall cycle the cooling fans on and off as required.

7. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).

8. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

9. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

10. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add an AC line reactor.

11. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120. Input and output current ratings must be shown on the VFD nameplate.

12. The VFD shall include a coordinated AC transient surge protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

13. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and/or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.

14. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure / jam condition causing motor overload

15. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and/or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for "two zone" control.

16. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and/or over the serial communication bus.

17. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.

F. All VFDs to have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.

2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.

3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (ie. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.

4. Two (2) programmable analog inputs shall accept current or voltage signals.

5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.

6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC or 24VAC.

7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.

8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display "start enable 1 (or 2) missing". The safety input status shall also be transmitted over the serial communications bus.

9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes

open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.

10. Seven (7) programmable preset speeds.

11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.

13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.

14. The VFD shall include password protection against parameter changes.

G. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:

1. Start-up assistant

2. Parameter assistants

   a. PID assistant

   b. Reference assistant

   c. I/O assistant

   d. Serial communications assistant

   e. Option module assistant

   f. Panel display assistant

g. Low noise set-up assistant

3. Maintenance assistant

4. Troubleshooting assistant

5. Drive optimizer assistants

H. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

1. Output Frequency

2. Motor Speed (RPM, %, or Engineering units)

3. Motor Current

4. Motor Torque

5. Motor Power (kW)

6. DC Bus Voltage

7. Output Voltage

I. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.

J. Serial Communications

1. The VFD shall have an EIA-485 port as standard. The protocols shall be, BACnet MS/TP. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by

the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.

2. The BACnet connection shall be an EIA-485, MS/TP interface operating at a baud rate of 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

   a. Data Sharing – Read Property – B.

   b. Data Sharing – Write Property – B.

   c. Device Management – Dynamic Device Binding (Who-Is; I-Am).

   d. Device Management – Dynamic Object Binding (Who-Has; I-Have).

   e. Device Management – Communication Control – B.

3. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional / integral /derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.

4. Serial communication in bypass shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault

information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.

5. The VFD / bypass shall allow the DDC to control the drive and bypass digital and analog outputs via the serial interface, excluding safety points and any critical hardwire points such as start/start, remote shutdown, etc... This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the DDC system. This allows for remote monitoring of which (of up to 4) safeties are open.

6. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.

K. EMI / RFI filters. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level with up to 100 feet of motor cable. No Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment.

L. All VFD's through 75HP at 480 V shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not sustain damage from this power mis-wiring condition.

M. Features – Features to be furnished and mounted by the drive manufacturer. All features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

1. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor per section 2.01K below.

2. Fieldbus adapters - Protocols such as BACnet MSTP shall be provided. Fieldbus adapter shall be integral to the unit during operation and located inside the unit, externally mounted Fieldbus adapter is not permitted. Fieldbus adapter shall operate as outlined in section 2.2.J of this specification. Fieldbus adapter may be removable for serviceability. Coordinate with appropriate communications protocol with BMS vendor.

N. Bypass Controller

1. A complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses are required. UL Listed motor overload protection shall be provided in both drive and bypass modes.

2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the "Off" position before either enclosure may be accessed. Provide bypass interlock for use by qualified personnel. Bypass contactor shall be NEMA rated and shall be equipped with solid-state electronic overloads.

3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 amps and this rating shall be indicated on the UL data label.

4. The drive and bypass package shall be seismic certified and labeled to the IBC:

   a. Seismic importance factor of 1.5 rating is required, and shall be based upon actual shake table test data as defined by ICC AC-156.

5. Drive Isolation Fuses - To ensure maximum possible bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted.

6. The system (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage range. The system shall incorporate circuitry that will allow the

drive or bypass contactor to remain "sealed in" over this voltage tolerance at a minimum.

7. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.

8. Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.

9. The bypass system shall NOT depend on the VFD for bypass operation. The bypass system shall be designed for stand alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed.

10. Serial communications – the bypass shall be capable of being monitored and / or controlled via serial communications. On-board communications protocols shall include BACnet MSTP.

11. Serial communication capabilities shall include, but not be limited to; bypass run-stop control; the ability to force the unit to bypass; and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus and / or via a Form-C relay output – keypad "Hand" or "Auto" selected, bypass selected, and broken belt indication. The DDC system shall also be able to monitor if the motor is running in the VFD mode or bypass mode over serial

communications. All of the field serial communications points shall be capable of being monitored in the bypass mode.

12. The bypass serial communications shall allow control of the bypass' digital outputs via the serial interface. This control shall be independent of any bypass function or operating state. The bypass' digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the bypass' digital inputs shall be capable of being monitored by the DDC system.

13. There shall be an adjustable motor current sensing circuit for the bypass and VFD modes to provide proof of flow (broken belt) indication. The condition shall be indicated on the keypad display, transmitted to the DDC system and/or via a Form-C relay output contact closure. The broken belt indication shall be programmable to be a system (drive and bypass) indication. The broken belt condition sensing algorithm shall be programmable to cause only a warning or a fault and / or system shutdown.

14. The digital inputs for the system shall accept 24VAC or 24VDC inputs. The bypass shall incorporate an internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 mA of 24 VDC for use by others to power external devices.

15. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, time-clock control, digital input, or serial communications) the bypass shall provide a dry contact closure that will signal the damper to open (motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a bypass system input and allows motor operation. Up to four separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. This feature will also operate in Fireman's override / smoke control mode.

16. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor condition shall be indicated on the bypass LCD display, programmed to fire a Form-C relay output, and / or over the serial communications protocol.

17. The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.

18. There shall be a keypad adjustment to select manual or automatic transfer bypass. The user shall be able to select via keypad programming which drive faults will result in an automatic transfer to the bypass mode and which faults require a manual transfer to bypass. The user may select whether the system shall automatically transfer from drive to bypass mode on the following drive fault conditions:

    a. Over current

    b. Over voltage

    c. Under voltage

    d. Loss of analog input

19. The following operators shall be provided:

    a. Bypass Hand-Off-Auto

    b. Drive mode selector

    c. Bypass mode selector

    d. Bypass fault reset

20. The bypass shall include a two line, 20 character LCD display. The display shall allow the user to access and view:

    a. Energy savings – in US dollars

    b. Bypass motor amps

    c. Bypass input voltage– average and individual phase voltage

    d. Bypass power (kW)

    e. Bypass faults and fault logs

    f. Bypass warnings

g. Bypass operating time (resettable)

h. Bypass energy (kilowatt hours – resettable)

i. I/O status

j. Parameter settings / programming

k. Printed circuit board temperature

21. The following indicating lights (LED type) or keypad display indications shall be provided. A test mode or push to test feature shall be provided.

a. Power-on (Ready)

b. Run enable

c. Drive mode selected

d. Bypass mode selected

e. Drive running

f. Bypass running

g. Drive fault

h. Bypass fault

i. Bypass H-O-A mode

j. Automatic transfer to bypass selected

k. Safety open

l. Damper opening

m. Damper end-switch made

22. The Bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs. This I/O allows for a total System (VFD and Bypass) I/O count of 24 points as standard. The bypass I/O shall be available to the BAS / DDC system even with the VFD removed.

23. The on-board Form-C relay outputs in the bypass shall programmable for any of the following indications.

    a. System started

    b. System running

    c. Bypass override enabled

    d. Drive fault

    e. Bypass fault

    f. Bypass H-O-A position

    g. Motor proof-of-flow (broken belt)

    h. Overload

    i. Bypass selected

    j. Bypass run

    k. System started (damper opening)

    l. Bypass alarm

    m. Over temperature

24. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

25. The bypass shall include a supervisory control mode. In this bypass mode, the bypass shall monitor the value of the VFD's analog input (feedback). This feedback value is used to control the bypass contactor on and off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps even with the VFD out of service.

26. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display

indications include "FireStat", "FreezStat", "Over pressure" and "Low suction". The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

27. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer the motor from VFD mode to Bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. The Smoke Control Override Mode action is not programmable and will always function as described in the bypass User's Manual documentation. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties as required by UL 864/UUKL. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.

28. Fireman's Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to acknowledge some digital inputs, all digital inputs, ignore digital inputs or any combination of the above. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for "Run-to-Destruction". The user may also force the unit into Override 2 via the serial communications link.

29. Class 10, 20, or 30 (programmable) electronic motor overload protection shall be included.

30. The VFD Product Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

2.3 SOLID-STATE REDUCED-VOLTAGE MOTOR STARTERS - NOT USED

2.4 MOTOR STARTERS AND CONTROLS

A. Refurbish motor controllers and starters in accordance with the following:

1. Provide three-position, maintained contact rotary selector switch (H-O-A) in starter covers for all automatically controlled motors.

2. Provide H-O-A switch with pilot light (1 pilot light to indicate "Motor On"). Pilot light shall be LED type with red or green jewel.

2.5 MOTOR CONTROL CENTERS - NOT USED

2.6 REMOTE DEVICES

A. Remote "Emergency stop" maintained contact switch, "Hand-off-auto" selector switch, pilot light, and similar devices, shall be of same manufacture as the associated starter, and shall be oiltight.

B. Remote pilot light shall be LED type.

C. Remote "Emergency Stop" and other contact making devices shall be pilot duty rated.

D. Wiring shall be connected so as to prevent unintentional starting by the grounding of any wire or wires outside of the starter enclosure.

2.7 FACTORY FURNISHED CONTROL PANELS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Motor starters and accessories installed, not in strict compliance with the above, shall be replaced at no cost to the City of New York.

3.2 ELECTRICAL WIRING

A. Provide all necessary wiring diagrams indicating wire size and connections as required for the proper operation of the equipment.

B. Contractor shall be responsible for replacing all fuses in the electrical systems during construction which blow due to tests or malfunction of his motorized or non-motorized electrical equipment.

3.3 INSTALLATION

A. Assembly:

1. Make required mechanical and electrical connections including those indicated on approved shop drawings.

2. Touch-up paint all marred factory finishes.

B. Overload Elements:

1. Provide in accordance with motor nameplate current, service factor and ambient temperature.

2. With clamp-on ammeter verify loading of motors. Where overloading occurs, do not increase thermal elements unless directed by Engineer.

C. Tighten and torque electrical connections in accordance with manufacturer's instruction and UL 486.

3.4 TESTING

A. Coordinate testing of starter with testing of the motor and the system associated with the motor.

B. For VFD installations, perform vibration testing of new motor/drive assembly to ensure that no torsional vibration exists.

3.5 REMOTE MAINTAINED CONTRACT EMERGENCY STOP AND RESET PUSHBUTTONS

A. Remote maintained contact emergency stop and reset pushbuttons shall be wired ahead of all other motor control devices and shall interrupt the motor control circuit in both the "Hand" and "Automatic" positions.

3.6 VFD INSTALLATION

A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.

Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. Caution: VFDs supplied without internal reactors have substantially higher input current ratings, which may require larger input power wiring and branch circuit protection. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

END OF SECTION

SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gate valves.
2. Globe valves.
3. Ball valves.
4. Plug valves.
5. Butterfly valves.
6. Check valves.

B. Related Sections:

1. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for pipe hangers and supports.
3. Section 23 07 00 - HVAC Insulation: Product and installation requirements for insulation for valves.
4. Section 23 21 16 - Hydronic Piping Specialties: Product and installation requirements for piping specialties used in hydronic piping systems.
5. Section 23 22 16 - Steam and Condensate Piping Specialties: Product and installation requirements for piping specialties used in steam and steam condensate, piping systems.

1.2 REFERENCES

A. ASTM International:

1. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 68 - High Performance Butterfly Valves.
2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
6. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
7. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

C. Code Compliance:

1. Furnish materials in accordance with NYCBC and NYCMC.

1.3 SUBMITTALS

A. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

B. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

C. Valve charts and tags.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NYCBC.

B. All valves shall have a rating exceeding system operating pressure at system temperature and not less than a minimum working pressure of 125 psig or 150 psig.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 DELIVERY, STORAGE AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.9 EXTRA MATERIALS

A. Furnish two packing kits for each size valve.

PART 2 - PRODUCTS

2.1 GATE VALVES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

1. Crane Valve, North America.

2. Milwaukee Valve Company.

3. NIBCO, Inc.

4. Stockham Valves & Fittings.

B. 2 inches (50 mm) and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, threaded bonnet, non-rising stem, hand-wheel, inside screw with back-seating stem, solid wedge disc, alloy seat rings, threaded ends.

C. 2-1/2 inches (65 mm) and Larger: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 inches (150 mm) and larger mounted over 8 feet (2400 mm) above floor.

D. 2 inches (50 mm) and Smaller: MSS SP 80, Class 200, bronze body, bronze trim, union bonnet, rising stem, hand-wheel, solid wedge disc, stainless steel rings, threaded ends.

E. 2-1/2 inches (65 mm) and Larger: MSS SP 70, Class 200, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc, flanged ends. Furnish chain-wheel operators for valves 6 inches (150 mm) and larger mounted over 8 feet (2400 mm) above floor.

2.2 GLOBE VALVES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

1. Crane Valve, North America.

2. Milwaukee Valve Company.

3. NIBCO, Inc.

4. Stockham Valves & Fittings.

B. 2 inches (50 mm) and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, threaded bonnet, hand wheel, teflon composition disc, threaded ends.

C. 2-1/2 inches (65 mm) and Larger: MSS SP 85, Class 125, cast iron body, bronze trim, hand wheel, outside screw and yoke, flanged ends. Furnish

chain-wheel operators for valves 6 inches (150 mm) and larger mounted over 8 feet (2400 mm) above floor.

D. 2 inches (50 mm) and Smaller: MSS SP 80, Class 200, bronze body, bronze trim, union bonnet, rising stem, hand wheel, renewable stainless steel seat ring and disc, threaded ends.

E. 2-1/2 inches (65 mm) and Larger: MSS SP 85, Class 150 ASTM A216/A216M, cast carbon steel body, bronze trim, bolted bonnet, rising stem hand wheel, outside screw and yoke, flanged ends. Furnish chain-wheel operators for valves 6 inches (150 mm) and larger mounted over 8 feet (2400 mm) above floor.

2.3 BALL VALVES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

1. Crane Valve, North America.
2. Milwaukee Valve Company.
3. NIBCO, Inc.
4. Stockham Valves & Fittings.

B. 2 inches (50 mm) and Smaller: MSS SP 110, 400 psi (2760 kPa) WOG, one piece bronze body, chrome plated brass ball, full port, teflon seats, blow-out proof stem, solder or threaded ends, lever handle with balancing stops.

C. 1/4 inch (6 mm) to 1 inch (25 mm) for fuel oil: MSS SP 110, Class 125, two-piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.

D. 1-1/4 inch (32 mm) to 3 inch (76 mm) for fuel oil: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port.

2.4 PLUG VALVES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

1. DeZURIK, Unit of SPX Corp.

2. Flow Control Equipment, Inc.

3. Homestead Valve.

B. 2 inches (50 mm) and Smaller: MSS SP 78, Class 150, semi-steel construction, rectangular port, full pipe area, pressure lubricated, teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.

C. 2-1/2 inches (65 mm) and Larger: MSS SP 78, Class 150, semi-steel construction, rectangular port, full pipe area, pressure lubricated, teflon packing, flanged ends. Furnish worm gear-operated.

2.5 BUTTERFLY VALVES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

1. Crane Valve, North America.

2. Fisher.

3. Jamesbury.

B. 2-1/2 inches (65 mm) and Larger: MSS SP 68, Class 150.

1. Body: Carbon steel ASTM A105, lug ends, stainless steel stem, extended neck.

2. Disc: 316L stainless steel.

3. Seat: Resilient replaceable PTFE.

4. Handle and Operator: Infinite position lever handle with memory stop for 2-1/2" to 6". Furnish gear operators for valves 8 inches (200 mm) and larger, and chain-wheel operators for valves mounted over 8 feet (2400 mm) above floor.

C. Valves shall be high performance bubble-tight, dead-end service and bi-directional type.

2.6 CHECK VALVES

A. General Requirements:

1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

a. Crane Valve, North America.

b. Milwaukee

c. Jamesbury.

d. Stockham Valves & Fittings.

B. Horizontal Swing Check Valve:

1. 2 inches (50 mm) and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N disc, solder or threaded ends.

2. 2-1/2 inches (65 mm) and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends.

3. 2 inches (50 mm) and Smaller: MSS SP 80, Class 200, bronze body and cap, Y-pattern, bronze regrinding disc, solder or threaded ends.

4. 2-1/2 inches (65 mm) and Larger: MSS SP 71, Class 250, cast iron body, bolted cap, bronze or cast iron disc, flanged ends.

5. Provide valves capable of being refitted while the valve remains in the line.

C. Wafer Check Valves:

1. Class 250, cast-iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring.

2. Provide valves designed to open and close at approximately one foot differential pressure.

D. Lift Check Valves, 2 inches and Smaller:

1. Class 125; cast-bronze body and cap conforming to ASTM B 62; horizontal or angle pattern, lift-type valve, with stainless steel spring, bronze disc holder with renewable "Teflon" disc, and threaded ends.

2. Provide valves capable of being refitted and ground while the valve remains in the line.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify piping system is ready for valve installation.

B. Examine valve interior through the end ports for cleanliness, freedom from foreign matter and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.

C. Actuate valve through an open-close and close-open cycle. Examine functionally significant features such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

D. Examine threads on both valve and the mating pipe for form (i.e., out-of-round or local indentation) and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length and material. Check gasket material for proper size, material composition suitable for service and freedom from defects and damage.

F. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials and proper alignment.

G. Replace defective valves with new valves.

H. All steam pipe joints and fittings shall be inspected for welding defects by an approved Testing and Inspection Agency retained by the Contractor, per NYC Building Code.

I. Report and inspection data shall be submitted after completion of work and/or remediation of defective welding that have been discovered during inspection and X-Ray testing procedures.

J. Any weld deemed defective, in the opinion of the certified welding inspection and testing agency, shall be ground out for the full depth and re-welded to the testing agency's satisfaction, at no cost to the City of New York.

3.2 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install brass male adapters at both ends of the valves in copper piping system.

C. Install valves with clearance for installation of insulation and allowing access.

D. Provide access where valves and fittings are not accessible.

E. Valves shall be installed so they shall be readily accessible. For operation of valves not accessible for direct operation, furnish and install chain wheel, guide and sufficient length of chain to operate from floor level. Provide hooks for fastening chains out of the way. No valve shall be installed with the handle pointing downward. If, in the opinion of the Engineer, valves have been installed so as to create a hazardous and unsafe condition, Contractor shall make corrections as directed, without additional charge.

F. Valves in Mechanical or Fan Rooms more than 8'-0" above the floor shall be chain operated, with either double end chain wrenches or chain wheels.

G. Valves 8" and larger shall be provided with a 1" bypass valve of same pressure rating.

H. Systems shall be supplied with valves at all automatic valves and at all apparatus using steam or chilled water so located and arranged to give complete isolation and regulating control of the water.

I. The entire system shall be supplied with valves so located, arranged and operated as to give a complete regulating control to all fixtures and apparatus. Shut-off valves shall be provided at each piece of equipment or fixture. Every item of equipment shall be independently isolated by means of valves.

J. Valves, except as noted, shall be properly supported, independent of the piping.

K. Valves in copper tubing shall have soldered or brazed ends.

L. Valves, where exposed and used in connection with finished piping, shall be same finish as the pipe.

M. Valve manufacturer's representative shall instruct building operating personnel in proper maintenance of plug valves. Furnish equipment and lubricant for one (1) year service.

N. Furnish and connect to all valves, brass tags, polished or lacquered with stamp lettering or numbers filled in with black paint. Also furnish a schedule of all valve tags, framed in a polished hardwood frame and covered with plate glass.

3.3 VALVE APPLICATIONS

A. Valves 2-1/2" size and smaller used for water shutoff shall be ball valve type.

B. Valves 3" size and larger used for hot or cold water shutoff shall be high performance butterfly valve.

C. Valves 2-1/2" size and smaller used for hydronic bypass or for flow control shall be ball valve type. All by pass or flow control valves in steam piping shall be of the globe type.

D. Valves 3" size and larger used for controlling water flow at pumps and at equipment, and for bypass control shall be lubricated plug type.

E. Check valves used for water piping, 2" and smaller, shall be all bronze swing check valves with finished bronze trimmings and brazed or threaded ends.

F. Check valves used for water piping, 2-1/2" and larger, shall be cast iron body, bronze trimmings, swing check valves with flanged ends.

G. Gate valves shall be of the solid wedge type and shall be provided with gland and packing boxes, and have top seat for packing under pressure when wide open.

H. Valves for steam shut-off shall be gate type. Valves for steam throttling, control shall be globe type.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping relating to HVAC work.
10. Firestopping accessories.
11. Equipment bases and supports.

B. Related Sections:

1. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.
2. Section 23 21 16 - Hydronic Piping Specialties: Product and installation requirements for piping specialties used in hydronic piping systems.
3. Section 23 22 16 - Steam and Condensate Piping Specialties: Product and installation requirements for piping specialties used in steam and steam condensate, piping systems.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.

3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.

4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.

2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

4. MSS SP 77 - Guidelines for Supports – Contractual Relationship

5. MSS SP-127 - Bracing for Piping Systems

F. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Firestops.

4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.

5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 SUBMITTALS

A. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers. Include the following:

1. Manufacturer's technical literature showing hanger type (per MSS SP-69 Standard) material of construction, loading capacity and installation data.

2. Hanger assembly details, including multiple supports and riser supports.

3. Pipe attachment details for insulated lines including seismic restraints.

4. Details of anchors, guides and restraints.

5. Contractor shall submit pull-out strength for all inserts to the structural engineer for review.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit calculations sealed by a registered Engineer.

E. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.

2. Firestopping: Submit preparation and installation instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed Engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

H. Piping Layout Drawings:

1. Provide piping layouts for all HVAC piping systems at same scale as ductwork shop drawings; where such piping is shown on the coordination drawings, separate piping shop drawings for the same area shall also be submitted. Piping shop drawings shall show all hangers and supports, fittings, valves, strainers and accessories. They shall show all sections necessary to establish pipe elevations, shall identify hanger types and loads, and show all tie-ins to structure.

I. Engineering Data:

1. Before any anchor or support system is installed, submit engineering data drawings to the Architect for review indicating how performance standards specified here shall be met. The Contractor is responsible for the structural design and supports for these systems and must show his proposed systems on these drawings.

2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and

anchorage, as well as size and gauge of members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of New York and shall be signed and sealed by this Engineer.

J. Sleeve Layout Drawings: Indicating sleeves in foundation walls, slabs and roofs, grade beams, footings, sound isolation partitions and ceilings.

K. Concrete Pull-out Tests:

1. Contractor shall provide on-site testing by an accredited testing laboratory, demonstrating compliance with specifications. Testing shall be performed to the loading requirements of the New York City Building Code or by requirements of the Project Manual or5x the load being placed on the most heavily loaded anchor/support; whichever is most restrictive. Test a minimum of 3 anchors/supports in each zone, of each floor, evenly distributed over the area where anchors/supports will be installed. Tested anchors/supports can be used in the final assemblies. Submit reports to Commissioner.

1.4 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.

2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.

2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.

G. Perform Work in accordance with NYCBC.

1.5 PERFORMANCE CRITERIA

A. Anchoring/support systems shall be required to comply with the following:

1. Each anchor/support shall be able to hold 5x the load being placed or as required by the New York City Building Code; whichever is most restrictive.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by Commissioner.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 DELIVERY, STORAGE AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical and damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

1. Carpenter & Paterson Inc.

2. Anvil (formerly Grinnell).

3. Witch.

B. Pipe hangers and supports shall comply with the recommendation of Standards SP-58 and SP-69 of the Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, except where otherwise noted in the Specifications or on the Drawings.

C. The Contractor shall comply with the contractural relationships recommended for the Pipe Hanger Engineer and the Mechanical Contractor, as stated in Standard MSS SP-77 unless otherwise noted in the Contract Documents.

D. Pipe hangers shall be of the clevis, pipe-roll and pipe-clamp types.

1. Piping subject to lateral or vertical movements shall be provided with supports of the spring hanger type. No exceptions to this will be granted.

E. Pipe hangers shall be connected to the building structure as follows:

1. All water piping 8" and over shall be supported directly from beams or by means of auxiliary steel furnished and installed by this Contractor attached to beams by means of isolation hangers.

2. All other piping may be supported by inserts with sufficient holding capacity to support twice the calculated dead load. No expansion bolts shall be permitted without written permission from the Engineer.

F. Hangers supported from miscellaneous floor steel shall have approved I-beam clamps. I-beam clamps for hangers supporting piping two (2) inches and smaller shall be adjustable side beam clamp. Piping shall be 2-1/2 inches and larger. I-beam clamps shall be Universal forged steel beam clamps with nut right-hand thread.

G. Water piping of six (6) inches and over in banks shall be supported on trapeze hangers constructed of two (2) 4" channels with 1" threaded rods at each end. Top of each rod shall tie in auxiliary steel as specified hereinafter.

H. Provide all auxiliary steel necessary to transmit loads for piping and equipment installed to building beams.

I. Hydronic Piping:

1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.

2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.

3. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Larger: Carbon steel, adjustable, clevis. Provide cast iron roller for pipes with straight run large than 150 feet.

4. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis cast iron roller.

5. Hangers for Hot Pipe Sizes 6 inches (150 mm) and Larger: Adjustable steel yoke, cast iron roll, double hanger.

6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches (150 mm) and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.

8. Wall Support for Cold Pipe Sizes 3 inches (76 mm) and Smaller: Cast iron hooks.

9. Wall Support for Cold Pipe Sizes 4 inches (100 mm) and Larger: Welded steel bracket and wrought steel clamp.

10. Wall Support for Hot Pipe, any size: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

11. Vertical Support: Steel riser clamp.

12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

13. Floor Support for Hot Pipe Sizes 2 inches (50 mm) and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

14. Floor Support for Hot Pipe Sizes 2-1/2 inches (75 mm) and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

15. Copper Pipe Support: Copper-plated, carbon steel ring.

J. Steam and Steam Condensate Piping:

1. Conform to ASME B31.1, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.

2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis cast iron roller.

4. Hangers for Pipe Sizes 6 inches (150 mm) and Larger: Adjustable steel yoke, cast iron roll, double hanger.

5. Multiple or Trapeze Hangers for Pipe Sizes 4 inches (100 mm) and Smaller: Steel channels with welded spacers, roller chairs and hanger rods.

6. Multiple or Trapeze Hangers for Pipe Sizes 6 inches (150 mm) and Larger: Steel channels with welded spacers and hanger rods; cast-iron roll and stand.

7. Wall Support for Pipe Sizes tp to 5 inches (100 to 125 mm): Welded steel bracket and roller chair.

8. Wall Support for Pipe Sizes 6 inches (150 mm) and Larger: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll.

9. Vertical Support: Steel riser clamp.

10. Floor Support for Pipe Sizes 4 inches (100 mm) and Smaller: Roller chair and concrete pier or steel support.

11. Floor Support for Pipe Sizes 6 inches (150 mm) and Larger: Adjustable cast iron roll and stand steel screws, and concrete pier or steel support.

12. Copper Pipe Support: Copper-plated carbon-steel ring.

K. Trapeze and Clevis Hangers:

1. Where two or more lines run parallel and adjacent to each other, trapeze hangers may be used.

2. Secure pipes supported by trapeze hangers and not mounted on pipe rolls to trapeze with hold down pipe clamps or "J" bolts.

3. Support vertical piping passing through slabs with pipe clamps installed above slab, unless they are subject to expansion or contraction.

L. Roller Hangers:

1. Support hot lines (steam, hot water, steam condensate) 2 inches and larger on roller hangers. Support chilled water lines with straight runs (longer than 150 feet) on roller hangers.

M. Saddles and Shields:

1. Provide protective galvanized shield for supporting insulated lines 1-1/2 inches and smaller.

2. Provide galvanized saddles and roller hangers for supporting hot insulated lines 2" and larger and hard insulation for supporting cold insulated lines 2" and larger.

3. Insert insulation identical to pipe insulation in void between saddle and pipe.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms for formed concrete. Provide steel metal deck ceiling bolts with threaded rod attachment for concrete with metal decking. Size inserts to suit threaded hanger rods. Inserts and loading shall be reviewed and approved by the Engineer.

B. In areas where the concrete slab is exposed, inserts shall be installed flush with slab surface.

C. Where inserts are missed, drill through concrete slab and provide rod with recessed square steel plate and nut above slab. Under certain conditions, and only with written approval of the Engineer, double expansion anchors meet Federal Specification FF-S-325C, as manufactured by HILTI or approved equal, having BS&A number, may be installed in existing slabs.

2.4 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Schedule 40 Steel pipe or 18 gage (1.2 mm) thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel.

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

1. Thunderline Link-Seal, Inc.

2. NMP Corporation.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

1. Allied Tube & Conduit Corp.

2. B-Line Systems.

B. Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

2.7 FIRESTOPPING

A. Definitions:

1. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

B. System Description:

1. Firestopping Materials: UL 1479 to achieve fire ratings as noted on Architectural Drawings for adjacent construction, but not less than 1 hour fire rating.

a. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.

2. Surface Burning: ASTM E84 with maximum flame spread / smoke developed rating of 25/450.

3. Firestop interruptions to fire rated assemblies, materials, and components.

C. Performance Requirements:

1. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.

2. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

D. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Dow Corning Corp.

2. Fire Trak Corp.

3. Hilti Corp.

4. International Protective Coating Corp.

5. 3M fire Protection Products

6. Specified Technology, Inc.

E. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.

2. Foam Firestopping Compounds: Multiple component foam compound.

3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.

4. Fiber Stuffing and Sealant Firestopping: Composite of ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.

5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.

6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.

7. Firestop Pillows: Formed mineral fiber pillows.

2.8 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

1. Furnish UL listed products or products tested by independent testing laboratory.

2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.

2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Obtain permission from Engineer before using powder-actuated anchors.

D. Do not drill or cut structural members.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches (100 mm) and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.1, ASTM F708, MSS SP 58, MSS SP 69, MSS SP 89 and NYCMC.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch (13 mm) space between finished covering and adjacent work.

D. Place hangers within 12 inches (300 mm) of each horizontal elbow.

E. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.

F. Support vertical piping at every floor.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Provide copper plated hangers and supports for copper piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Prime coat steel hangers and supports. Refer to Section 09 90 00.

K. Provide clearance in hangers and from structure and other equipment for installation of insulation.

L. Provide all necessary hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing. All hangers and supports shall be capable of screw adjustment after piping is erected with a locking nut provided to prevent loss of adjustment due to pipe vibration. All supports and components shall be rated for a minimum of two times the calculated dead load.

3.5 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.

3.6 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.

D. Place intumescent coating in sufficient coats to achieve rating required.

E. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.

b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.

c. Pack void with backing material.

d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where conduit and wireway penetrate fire rated surface, install firestopping product in accordance with manufacturer's instructions.

F. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.

b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.

c. Install type of firestopping material recommended by manufacturer.

2. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied

spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

4. Interior partitions: Seal all pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.7 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.10 SCHEDULES

A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches (mm)	COPPER TUBING MAXIMUM HANGER SPACING Feet (m)	STEEL PIPE MAXIMUM HANGER SPACING Feet (m)	COPPER TUBING HANGER ROD DIAMETER Inches (mm)	STEEL PIPE HANGER ROD DIAMETER Inches (mm)
Up to 1-1/2 (38)	6 (1.8)	6 (1.8)	1/2 (13)	3/8 (9)
2 (50)	8 (2.4)	8 (2.4)	1/2 (13)	1/2 (13)
2-1/2 (65)	10 (3)	10 (3)	5/8 (15)	5/8 (15)
3 (75)	10 (3)	10 (3)	5/8 (15)	5/8 (15)
4 (100)	-	10 (3)	-	3/4 (19)
5 (125)	-	10 (3)	-	3/4 (19)
6 (150)	-	10 (3)	-	3/4 (19)
8 (200)	-	10 (3)	-	7/8 (22)

PIPE SIZE Inches (mm)	COPPER TUBING MAXIMUM HANGER SPACING Feet (m)	STEEL PIPE MAXIMUM HANGER SPACING Feet (m)	COPPER TUBING HANGER ROD DIAMETER Inches (mm)	STEEL PIPE HANGER ROD DIAMETER Inches (mm)
10 (250)	-	10 (3)	-	1 (25)
12 (300)	-	10 (3)	-	1 (25)
14 (350) - 20 (500)	-	12 (3) -	-	1-1/4 (32)

When several pipes rest on a common hanger, increase rod diameter accordingly, and spacing noted above must remain.

END OF SECTION

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SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.
2. Owner's color code, if any.

1.3 SUBMITTALS

A. General Conditions - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturers catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples: Submit two tags, labels and pipe markers used on project.

E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories, and owner's color code.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by Commissioner.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Craftmark Identification Systems.

2. Safety Sign Co.

3. Seton Identification Products

B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color: 2" x 1" x 1/8" thick with 1/4" high characters.

2.2 TAGS

A. Metal Tags:

1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

a. Craftmark Identification Systems.

b. Brady

c. Seton Identification Products

2. Brass with stamped letters; tag size minimum 2 inches (38 mm) diameter with finished edges.

B. Information Tags:

1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

a. Craftmark Identification Systems.

b. Brady

c. Seton Identification Products

2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches (83 x 143 mm) with grommet and self-locking nylon ties.

C. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame.

2.3 STENCILS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Craftmark Identification Systems

2. Brady

3. Seton Identification Products

B. Stencils: With clean cut symbols and letters of following size:

1. Ductwork and Equipment: 2 inches (50 mm) high letters.

C. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1 and owner's color code.

B. Plastic Pipe Markers:

1. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

a. Craftmark Identification Systems.

b. Brady

c. Seton Identification Products

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

2.5 LABELS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Craftmark Identification Systems.

2. Brady

3. Seton Identification Products

B. Description: Aluminum size 1.9 x 0.75 inches (48 x 19 mm), adhesive backed with printed identification.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting in accordance with Section 09 90 00.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Identify control panels and major control components outside panels with nameplates.

G. Identify valves in main and branch piping with tags.

H. Identify air terminal unit valves with numbered tags.

I. Tag automatic controls, instruments, and relays. Key to control schematic.

J. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

K. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

L. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

A. Provide color-coded valve schedule for each system and enclose in Lexan frame.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, adjusting and balancing of air systems.
2. Testing, adjusting and balancing of hydronic, steam and refrigerating systems.
3. Measurement of final operating condition of HVAC systems.
4. Sound measurement of equipment operating conditions.
5. Vibration measurement of equipment operating conditions.

B. Related Sections:

1. Section 23 09 23 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.
2. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation for HVAC equipment.

1.2 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

A. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty or a Copy of NEBB Certificate of Conformance Certification.

B. Prior to commencing Work, submit contractor's qualification including the past three (3) year experience and reference projects and proof of latest calibration date of each instrument.

C. Test Reports: Indicate data on either AABC MN-1 National Standards for Total System Balance forms, forms prepared following ASHRAE 111 or NEBB Report forms.

D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

E. Submit draft copies of report for review prior to final acceptance of Project.

F. Furnish reports in soft cover, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets (where required) and equipment identified to correspond with data sheets, and indicating thermostat locations. Reports shall be signed/sealed by a Licensed Professional Engineer in the state where the project is located.

G. Preliminary Effort:

1. Immediately after award of the Contract, the Contractor shall review the Drawings and Specifications and shall indicate any deficiencies (or additional features) in the air or water systems which would preclude (or improve) proper adjusting or balancing. These include:

a. Additional air volume dampers.

b. Additional water balance devices.

c. Installation of additional air flow measuring devices.

d. Installation of additional "Pete's Plugs" ports, etc.

2. Submit for approval sample forms that he intends to use for tabulating balancing reports which shall include fan and pump or other equipment tags or labels. These forms should be similar to the AABC forms or NEBB equivalent.

3. Describe the instrumentation (including accuracy limitations) of each device proposed for use on this project for air and water balancing. As a minimum, instrumentation usage application and accuracy limitations acceptable on this project shall be those described in "HVAC Systems - Testing, Adjusting and Balancing" published by Sheet Metal and Air-Conditioning National Association, Inc. (SMACNA).

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of flow measuring stations balancing valves and rough setting.

B. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NYCBC.

B. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance, ASHRAE 111 or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

C. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

1.6 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three (3) years documented experience certified by AABC or Certified by NEBB.

B. Perform Work under supervision of AABC registered professional engineer experienced in performance of this Work and licensed in State of New York.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 SEQUENCING

A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.9 SCHEDULING

A. Schedule and provide assistance in final adjustment and test of life safety smoke evacuation and smoke control systems with Fire Authority.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify systems are complete and operable before commencing work. Verify the following:

1. Systems are started and operating in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Existing filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems in the vicinity of the air handling unit are clean of debris.
6. Fans are rotating correctly.
7. Volume dampers are in place and operational.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air ducts/outlets are installed and connected.
11. Duct system leakage is minimized. Duct leak tests are approved

12. Hydronic systems are flushed, filled, vented and pressure tested.

13. Pumps are rotating correctly.

14. Proper strainer baskets are clean and in place or in normal position.

15. Service and balancing valves are open.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to Commissioner to facilitate spot checks during testing.

C. Periodic Inspections Of The Project During Construction

1. Prior to commencement of balancing, the Contractor shall make periodic inspections of the project during construction (as noted below) and shall report in writing to the Commissioner any deviations from Contract Documents relating to testing, balancing, and adjustment work concerning:

a. Equipment:

1) Installation

2) Placement

b. Inaccessible installation of the following balancing hardware:

1) Ports

2) Plugs

3) Balance damper handles

4) Other such items

3.3 EXECUTION

A. The Contractor and its selected and approved balancing firm shall report to and review the work required with the Commissioner prior to beginning of work. At least two (2) one-day inspections of the Water and Air Systems at appropriate times during construction shall be made by the balancing firm and it shall report its findings to the Commissioner. All

openings, pressure taps, wells and closures required, over and above those shown on the drawings, to perform the required test and adjustments shall be installed during or after construction at no additional cost to the City of New York.

B. The Contractor shall furnish all services for a minimum of two complete adjustments of water systems and air handling and exhaust systems, water and air distribution and controls, for the first cooling season and for the first heating season after the job is in complete operation under load conditions.

C. During all tests, it shall be demonstrated that the systems are free from leaks and that all parts of the system will operate correctly. The Balancing firm shall make final adjustments to all equipment and controls as may be required for proper operation, maintaining correct temperatures in all parts of the building. Controls shall be adjusted by the Control Manufacturer's mechanics on the advise of the balancing firm.

D. The final test report shall include appropriate reference to all problems regarding the system(s) encountered prior to, during and after testing and what action should be taken to correct the problem(s), including noise and vibration.

E. The following work shall be included by the balancing firm:

1. Contractor shall perform vibration testing of new motor/drive assembly to ensure that no torsional vibration exists.

2. Supervise the balancing of all water circulation systems and parts thereof installed under the Contract to obtain the water quantities and temperature drops in all parts of the system specified in the plans and in the specifications, or as required by the Licensed Professional Engineer.

3. Supervise the balancing of the air conditioning and ventilating systems to achieve the air quantities specified at each air inlet, outlet and damper shown on the plans at the proper conditions of static pressure and temperature differential. Conduct all leakage tests on high (pressure) velocity ductwork in a manner acceptable to the Commissioner. Leakages shall not exceed 3% of total air to be delivered.

4. Enlist and provide cooperation of equipment manufacturer where needed to obtain proper equipment performance. Adjust/change

motor or fan sheaves to field design capacity or most efficient operation conditions as required.

5. Study and report on noise and vibration problems which may develop in the course of system balancing.

6. Submit separate reports on the cooling and heating water circulating systems, ATC system, and heating and ventilating systems. These reports shall certify test methods and instruments used, all readings obtained, temperature and pressure drops, RPM of equipment, amperage of all motors, air quantities at each outlet supply, return and air balancing problems encountered, and suggestions. Reports to be submitted to Commissioner shall include data on all tests in the form normally used by AABC and NEEB. The reports must, however, be varied to suit these specifications. Reports shall include fan and pump curves for the final speeds developed from the fan manufacturer's performance test data for all major equipment and schematics for all systems tested.

7. Perform tests on heating systems when the outside temperature is averaging less than 30°F and on cooling systems when the outside temperature is above 80°F.

8. Instruct the Building Maintenance employees for a minimum of two weeks during the adjusting and balancing period. Obtain signed statements form each employee verifying this instruction has been received by each.

9. Carry out the "start-up" of the various systems with the Contractor and with any necessary assistance of the equipment manufacturer's representative.

10. Furnish all instruments and provide all instrumentation required to perform the above work. The equipment and instrumentation shall remain the property of the balancing subcontractor, however, all equipment must be first approved by the Architect before being used on the project.

11. Assist the Commissioning Agent to complete the project commissioning procedure.

3.4 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design.

B. Air Outlets and Inlets: Adjust total to within plus 5 percent and minus 5 percent of design to space.

C. Hydronic Systems: Adjust to within plus or minus 5 percent of design.

3.5 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Report defects and deficiencies noted during performance of services, preventing system balance.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Commissioner.

G. Prior to starting of balancing work, the Contractor shall:

1. Adjust all balancing cocks and dampers open.

2. Fill, vent, and clean all water systems.

3. Place all equipment in operating condition.

4. Clean all strainers.

5. Verify replacement of all existing dirty air filters with new. Provide new as required.

H. For the duration of the balancing work, the Contractor shall:

1. Maintain mechanics at project at all times for system operation, trouble shooting, assistance, etc.

2. Adjust fan drives or blade pitch or replace sheaves as required to meet system performance requirements.

3. Provide necessary mechanical adjustments in conjunction with balancing procedure.

4. Replace all balancing valves or dampers in systems that cannot be manipulated to satisfy balancing requirements.

I. Standard size (5" x 8") index cards, i.e. "check-out cards", shall be enclosed in a Vinafilm binder securely attached to each device as per the above.

J. In cooperation with the Contractor, the Contractor shall check and verify the satisfactory performance of static pressure of mass flow synchronization control loops and the ability of each control loop to hold a set-point and maintain stable fan or flow synchronization control. Operating tolerances for each loop set-point shall be obtained from the ATC Contractor.

K. The Contractor shall use flow meters where they are required for taking data. This shall include the use of air flow metering stations for air flow measurement in preference to taking data via pitot-static tube traverses of ducts where such devices can be used. Where pitot-static tube traverses are performed, the Contractor shall seal test holes with snap-in plugs or he shall use approved caps made for this purpose. The use of tape to seal test holes shall not be allowed.

L. With all boxes in the duct system set at maximum flow, the fan capacity output and static pressure capability shall be determined by measurement and it shall be recorded. Fan capacity deficiencies shall be noted, recorded and reported to the Commissioner for corrective action. Duct leakage estimates shall also be noted and recorded and, if in excess of specified allowable reported to the Commissioner for corrective action.

M. After satisfactory balance has been achieved, reset the duct system static pressure controller to the lowest set point compatible with scheduled air delivery.

N. Note and record any box controller limit setting by number where applicable.

O. If the supply and return air flow serving a particular zone are synchronized for system self-balancing purposes, confirm by measurements the capacity and action of the self balancing control loop to track and maintain differential flow requirements. Instrument signal air supply pressures will be recorded where possible, depending upon the control loop's supplier.

P. The aim of all balancing adjustments shall be the minimum use of energy for fluid transport.

Q. All fans should be set at their lowest rpm or blade pitch to provide design flow; air dampers are to be used only for final trim.

R. The Contractor shall verify accuracy and calibrate all measurement devices (flow sensors, pressure sensors, temperature devices, etc.) provided by Controls Contractor.

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Effect volume control by using volume dampers located in ducts. The intent is to utilize minimum site energy and all fan systems should be properly setup to their lowest rpm to achieve design flow rates. Air dampers are to be used for final trim only.

D. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

E. Provide system schematic with required and actual air quantities recorded at each test point.

F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

H. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

I. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

J. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

K. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.

L. Verify that leakage on terminal boxes is within the allowable rates, not to exceed 2 percent of design flow.

M. For all air systems, testing shall be done in all modes including minimum outside air mode and 100% economizer mode, etc.

3.7 WATER SYSTEM PROCEDURE

A. Adjust water systems, after air balancing, to obtain design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.

C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.8 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing but not limited to the following:

1. Air Coils.

2. Air Handling Units.

3. Fans.

B. Report Forms:

1. Title Page:

a. Name of Testing, Adjusting, and Balancing Agency

b. Address of Testing, Adjusting, and Balancing Agency

c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency

d. Project name

e. Project location

f. Project Engineer

g. Project Contractor

h. Project altitude

i. Report date

2. Summary Comments:

a. Design versus final performance

b. Notable characteristics of system

c. Description of systems operation sequence

d. Summary of outdoor and exhaust flows to indicate building pressurization

e. Nomenclature used throughout report

f. Test conditions

3. Instrument List:

a. Instrument

b. Manufacturer

c. Model number

d. Serial number

e. Range

f. Calibration date

4. Electric Motors:
   a. Manufacturer
   b. Model/Frame
   c. HP/BHP and kW
   d. Phase, voltage, amperage; nameplate, actual, no load
   e. RPM
   f. Service factor
   g. Starter size, rating, heater elements
   h. Sheave Make/Size/Bore
5. V-Belt Drive:
   a. Identification/location
   b. Required driven RPM
   c. Driven sheave, diameter and RPM
   d. Belt, size and quantity
   e. Motor sheave diameter and RPM
   f. Center to center distance, maximum, minimum, and actual
6. Sound Level Report:
   a. Location
   b. Octave bands - equipment off
   c. Octave bands - equipment on
   d. RC level - equipment on
7. Vibration Test:
   a. Location of points:
      1) Fan bearing, drive end

2) Fan bearing, opposite end

3) Motor bearing, center (when applicable)

4) Motor bearing, drive end

5) Motor bearing, opposite end

6) Casing (bottom or top)

7) Casing (side)

8) Duct after flexible connection (discharge)

9) Duct after flexible connection (suction)

b. Test readings:

1) Horizontal, velocity and displacement

2) Vertical, velocity and displacement

3) Axial, velocity and displacement

c. Normally acceptable readings, velocity and acceleration

d. Unusual conditions at time of test

e. Vibration source (when non-complying)

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC piping insulation, jackets and accessories.

2. HVAC equipment insulation, jackets and accessories.

3. HVAC ductwork insulation, jackets, and accessories.

1.2 REFERENCES

A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

3. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

5. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

6. ASTM C450 - Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.

7. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

8. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

9. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.

10. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

11. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

12. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

14. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

15. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

16. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

17. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

18. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

19. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

20. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

21. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.

22. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

23. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

24. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

25. Con Edison Specification S-9021-6.

B. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

2. UL 1978 - Standard for Safety for Grease Ducts.

1.3 SUBMITTALS

A. General Conditions - Submittal Procedures: Submittal procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. Samples: Submit two samples of representative size illustrating each insulation type.

D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723 and NFPA 258.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Perform Work in accordance with NYCBC.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience approved by Commissioner.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:

1. CertainTeed.
2. Knauf.
3. Johns Manville.
4. Owens-Corning.

B. Manufacturers for Closed Cell Elastomeric Insulation Products:

1. Aeroflex. Aerocell.

2. Armacell, LLC. Armaflex.

3. Nomaco. K-flex.

C. Furnish materials in accordance with NYCBC.

2.2 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.

1. Thermal Conductivity: 0.23 at 75 degrees F (0.034 at 24 degrees C).

2. Operating Temperature Range: 0 to 850 degrees F (minus 18 to 454 degrees C).

3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.

4. Jacket Temperature Limit: minus 20 to 150 degrees F (minus 29 to 66 degrees C).

5. Density 10 PCF average.

B. TYPE P-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.

1. Thermal Conductivity: 0.27 at 75 degrees F (0.040 at 24 degrees C).

2. Operating Temperature Range: 0 to 650 degrees F (minus 18 to 343 degrees C).

3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.

4. Jacket Temperature Limit: minus 20 to 150 degrees F (minus 29 to 66 degrees C).

5. Density 10 PCF average.

C. TYPE P-4: ASTM C612; semi-rigid, fibrous glass board noncombustible.

1. Thermal Conductivity: 0.27 at 75 degrees F (0.040 at 24 degrees C).

2. Operating Temperature Range: 0 to 650 degrees F (minus 18 to 343 degrees C).

3. Density 10 PCF average.

D. TYPE P-5: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F (0.039 at 25 degrees C).

2. Operating Temperature Range: Range: Minus 70 to 180 degrees F (minus 57 to 82 degrees C).

E. TYPE P-6: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.30 at 75 degrees F (0.043 at 24 degrees C).

2. Maximum Service Temperature: 300 degrees F (149 degrees C).

3. Operating Temperature Range: Range: Minus 58 to 300 degrees F (minus 50 to 149 degrees C).

F. TYPE P-7: ASTM C534, Type I, flexible, nonhalogen, closed cell elastomeric insulation, tubular.

1. Thermal Conductivity: 0.27 at 75 degrees F (0.039 at 24 degrees C).

2. Maximum Service Temperature: 250 degrees F (120 degrees C).

3. Operating Temperature Range: Range: Minus 58 to 250 degrees F (minus 50 to 120 degrees C).

G. TYPE P-8: ASTM C547, Type I rigid, mineral fiber preformed pipe insulation, noncombustible.

1. Thermal Conductivity: 0.23 at 75 degrees F (0.034 at 24 degrees C).

2. Maximum Service Temperature: 1200 degrees F (649 degrees C).

3. Reinforced Fail Vapor Retarding Jacket: UL listed and treated with fire retardant lagging adhesive. ASTM E93.

4. Consisting of single layer thickness to comply with requirement.

2.3 PIPE INSULATION JACKETS

A. PVC Plastic Pipe Jacket:

1. Product Description: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.

2. Thickness: 10 mil (0.25 mm).

3. Connections: Pressure sensitive color matching vinyl tape.

B. Aluminum Pipe Jacket:

1. ASTM B209.

2. Thickness: 0.016 inch (0.40mm) thick sheet.

3. Finish: Smooth.

4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.

5. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.

6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 3/8 inch (10 mm) thick aluminum.

C. Field Applied Glass Fiber Fabric Jacket System:

1. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2. Glass Fiber Fabric:

a. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.

b. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.

c. Weave: [5 x 5] [10 x 10] [10 x 20].

3. Indoor Vapor Retarder Finish:

a. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.

b. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.4 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 inches (40 mm) diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping 2 inches (50 mm) diameter and larger: Steel saddle. Inserts length: not less than 6 inches (150 mm) long, matching thickness and contour of adjoining insulation.

E. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

F. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

G. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

H. Adhesives: Compatible with insulation.

2.5 EQUIPMENT INSULATION

A. TYPE E-2: ASTM C612; glass fiber, rigid board, noncombustible with factory applied reinforced aluminum foil jacket.

1. Thermal Conductivity: 0.24 at 75 degrees F (0.035 at 24 degrees C).

2. Operating Temperature Range: 0 to 450 degrees F (minus 18 to 232 degrees C).

3. Density: 3.0 pound per cubic foot (48 kilogram per cubic meter).

4. Jacket Temperature Limit: minus 20 to 150 degrees F (minus 29 to 66 degrees C).

B. TYPE E-5: ASTM C612; glass fiber, semi-rigid board, noncombustible.

1. Thermal Conductivity: 0.23 at 75 degrees F (0.033 at 24 degrees C).

2. Maximum Operating Temperature: 850 degrees F (450 degrees C).

3. Density: 3.0 pound per cubic foot (48 kilogram per cubic meter).

C. TYPE E-7: ASTM C612-93; Type V, thermafiber board, asbestos free.

1. Thermal Conductivity: 0.46 at 400 degrees F (0.0664 at 227 degrees C).

2. Maximum Operating Temperature Range: 1900 degrees F (1038 degrees C).

3. Density: 18.5 PCF

D. TYPE E-8: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.

1. Thermal Conductivity: 0.27 at 75 degrees F (0.039 at 25 degrees C).

2. Operating Temperature Range: Range: Minus 70 to 220 degrees F (minus 57 to 105 degrees C).

2.6 DUCTWORK INSULATION

A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.25 at 75 degrees F (0.036 at 24 degrees C).

2. Maximum Operating Temperature: 250 degrees F (121 degrees C).

3. Density: 1.5 pound per cubic foot (24 kilogram per cubic meter).

B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied all service facing meeting ASTM C1136, Type II.

1. Thermal Conductivity: 0.22 at 75 degrees F (0.032 at 24 degrees C).

2. Density: 4.25 pound per cubic foot (68 kilogram per cubic meter).

C. Type D-3: Fire-wrapping for kitchen exhaust duct, smoke control duct stair pressurization and other locations indicated on the drawings.

1. Fire-rated flexible duct wrap insulation shall be assembled and tested in accordance with ISO 6944, ASTM E-814/UL 1479, ASTM E-84/UL 723, ASTM E-136 and ASTM C-518.

2. The assembly shall comply with NYC CC and Building Bulletins 2009-028 and 2010-021.

3. One layer of wrapping shall have 2 hours F-rating and 2 hours T-rating.

4. Minimum 6 pound per cubic foot density.

5. Product from Scrim Encapsulated.

6. OTCR approved.

7. Accepted Manufactures:

   a. 3M.

   b. Unifrax Corp.

D. TYPE D-4: ASTM C1071, Type I, flexible, glass fiber duct liner with coated air side.

1. Thermal Conductivity: 0.24 at 75 degrees F (0.036 at 24 degrees C).

2. Density: 1.5 pound per cubic foot (24 kilogram per cubic meter).

3. Maximum Operating Temperature: 250 degrees F (121 degrees C).

4. Maximum Air Velocity: 2,000 feet per minute (30.5 meter per second).

5. 1 inch minimum.

6. Treated with EPA register anti-microbial agent proven to resist microbial growth as determined by ASTM G-21 and G-22.

E. TYPE D-5: ASTM C1071, Type II, rigid, glass fiber duct liner with coated air side.

1. Thermal Conductivity: 0.23 at 75 degrees F (0.033 at 24 degrees C).

2. Density: 3.0 pound per cubic foot (48 kilogram per cubic meter).

3. Maximum Operating Temperature: 250 degrees F (121 degrees C).

4. Maximum Air Velocity: 4,000 feet per minute (20.3 meter per second).

5. 1 inch minimum.

6. Treated with EPA register anti-microbial agent proven to resist microbial growth as determined by ASTM G-21 and G-22.

2.7 DUCTWORK INSULATION JACKETS

A. Outdoor Duct Jacket: Flexible self-adhering weatherproof system similar to Flex Clad 250.

B. Membrane Duct Jacket: ASTM D4637; Type I, EPDM; non-reinforced, 0.060 inch 1.5 mm) thick, 48 inch (1220mm) wide roll; white color.

2.8 DUCTWORK INSULATION ACCESSORIES

A. Vapor Retarder Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

B. Vapor Retarder Lap Adhesive: Compatible with insulation.

C. Adhesive: Waterproof, ASTM E162 fire-retardant type.

D. Liner Fasteners: Galvanized steel, welded with integral head.

E. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

F. Lagging Adhesive: Fire resistive to ASTM E84, NFPA 255 and UL 723.

G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

H. Adhesives: Compatible with insulation.

I. Membrane Adhesives: As recommended by membrane manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify piping, equipment and ductwork have been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less.

Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.

C. Piping Systems Conveying Fluids Below Ambient Temperature:

1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump and expansion joints.

2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.

3. Insulate fittings, joints, valves and all appurtenances with molded insulation of like material and thickness as adjacent pipe. Finish with PVC fitting covers.

D. Glass Fiber Board Insulation:

1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.

E. Hot Piping Systems less than 140 degrees F (60 degrees C):

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.

2. Insulate fittings, joints, valves and all appurtenances with molded insulation of like material and thickness as adjoining pipe. Finish with PVC fitting covers.

3. Insulate unions and flanges.

F. Hot Piping Systems greater than 140 degrees F (60 degrees C):

1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.

2. Insulate fittings, joints, valves and all appurtenances with molded insulation of like material and thickness as adjoining pipe. Finish with PVC fitting covers.

3. Insulate flanges and unions.

G. Inserts and Shields:

1. Piping 1-1/2 inches (40 mm) Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.

2. Piping 2 inches (50 mm) Diameter and Larger: Install saddle between support shield and piping and under finish jacket.

a. Insert Configuration: Minimum 6 inches (150 mm) long, of thickness and contour matching adjoining insulation; may be factory fabricated.

b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.

3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.

4. Inserts between the pipe and pipe hangers shall consist of rigid pipe insulation of equal thickness to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall be not less than following lengths:

2-1/2 in. pipe size and smaller	6 in. long
3 in. to 6 in. pipe size	9 in. long
8 in. to 10 in. pipe size	12 in. long
larger than 10 in. pipe size	18 in. long

H. Insulation Terminating Points:

1. Ducted Coil Branch Piping: Terminate hot water piping at the coil connections including coil header.

2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.

3. Condensate Piping: Insulate entire piping system and components to prevent condensation.

I. Closed Cell Elastomeric Insulation:

1. Push insulation on to piping.

2. Miter joints at elbows.

3. Seal seams and butt joints with manufacturer's recommended adhesive.

4. When application requires multiple layers, apply with joints staggered.

5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

J. High Temperature Pipe Insulation:

1. Install single layer to meet thickness scheduled. Multiple layers of insulation will not be accepted.

2. All insulation surfaces not in shaft construction, shall maintain a maximum of 100°F for piping insulation and 130°F for equipment insulation.

3. Stagger joints between jackets.

4. Supplied with pre-formed jacket.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Aluminum jacket and fitting covers.

L. Prepare pipe insulation for finish painting. Refer to Section 09 90 00.

M. Insulation at Strainers: Provide removable insulation.

3.3 INSTALLATION - DUCTWORK SYSTEMS

A. Duct dimensions indicated on Drawings are finished inside dimensions.

B. Insulated ductwork conveying air below ambient temperature:

1. Provide insulation with vapor retarder jackets.

2. Finish with tape and vapor retarder jacket.

3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor retarder jacket.

2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet (3 meters) above finished floor): Finish with aluminum jacket.

E. External Glass Fiber Duct Insulation:

1. Secure insulation with vapor retarder jacket with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.

2. Secure insulation without vapor retarder jacket with staples, tape, or wires.

3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.

4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.

5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

F. Duct and Plenum Liner:

1. Adhere insulation with adhesive for 100 percent coverage.

2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.

3. Seal and smooth joints. Seal and coat transverse joints.

4. Seal liner surface penetrations with adhesive.

5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.

6. Provide metal nosings at section joints.

G. Kitchen Exhaust Ductwork:

1. Cover duct by wrapping with insulation using overlap method.

2. Overlap seams of each method by 3 inches (76 mm).

3. Attach insulation using steel banding and clips.

4. Install insulation without sag on underside of ductwork. Use additional support to prevent sagging.

5. Install flex clad over the entire assembly to protect the insulation.

H. Ducts Exterior to Building:

1. Install insulation according to external duct insulation paragraph above.

2. Provide external insulation with vapor retarder jacket. Cover with outdoor jacket finished as specified in this Section.

3. Finish with membrane duct jacket.

4. Calk seams at flanges and joints. Located major longitudinal seams on bottom side of horizontal duct sections.

I. Prepare duct insulation for finish painting.

3.4 SCHEDULES

A. Cooling Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches (mm)
Chilled Water Supply and Return 40 to 60 degrees F	P-1	 All	1.5 (40) 1.5 (40)

B. Heating Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches (mm)
Heating Water Supply and Return 141 to 200 degrees F (61 to 93 degrees C)	P-1	1-1/2 inches (40 mm) and smaller 2 inches (50 mm) to 8 inches (100 mm)	1.5 (40)2.0 (50)
Heating Water Supply and Return 141 to 200 degrees F (61 to 93 degrees C)	P-2	10 inches (200 mm) and up	2.5 (65)
Low Pressure Steam Supply and condensate return up to 15 psi (103 kPa) up to 250 degrees F (121 degrees C)	P-1 P-3	1-1/2 inches (40 mm) and smaller 2 inches (50 mm) and up	1.5 (40) 3.0 (75)

C. Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	INSULATION THICKNESS inches (mm)
Outside Air Intake	D-2	2 (50)
Equipment Casings	D-2	2 (50)
Supply Ducts (internally insulated) in MER's or as specified	D-4	1.5 (40)
Return Ducts (internally insulated) in MER's or as specified	D-4	1.5 (40)
Supply ducts in MER's and exposed to view	D-2	1.5 (40)

END OF SECTION

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SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Air supply piping and tubing.
2. Control panel enclosures.
3. Humidistats.
4. Thermostats.
5. Time clocks.
6. Alarm system.
7. Control air dampers.
8. Electric damper actuators.
9. Control valves.
10. Electric valve actuators.
11. Outside air measuring and modulation device.
12. Direct digital control system components.
13. Duct-mounted smoke detector.
14. Differential pressure monitor.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors.
2. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
3. Section 23 21 16 - Hydronic Piping Specialties: Product requirements for thermometer sockets and gage taps for placement

by this section. Installation requirements for piping products furnished in this section.

4. Section 23 33 00 - Air Duct Accessories: Product requirements for duct mounted thermometers. Installation requirements for dampers and other duct mounted products furnished in this section.

5. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.

C. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

D. ASTM International:

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. ASTM A536 - Standard Specification for Ductile Iron Castings.

3. ASTM B32 - Standard Specification for Solder Metal.

4. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

5. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

6. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

7. ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing.

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

F. National Electrical Manufacturers Association:

1. NEMA DC 3 - Residential Controls - Electrical Wall Mounted Room Thermostats.

2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. National Fire Protection Association:

1. NFPA 72 - National Fire Alarm Code.

2. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

H. Underwriters Laboratories, Inc.:

1. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.

1.3 SUBMITTALS

A. General Conditions - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Coordinate submittals with information requested in Section 23 09 93.

C. Product Data: Submit description and engineering data for each control system component. Include sizing as required.

D. Samples: Submit two (2) of each type of room thermostat and cover, thermostat guard and each exposed control component.

E. Design Data: Indicate data for sizing of air tubing.

F. Manufacturer's Installation Instructions: Submit installation requirements for each control component.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors.

B. Operation and Maintenance Data: Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.5 QUALITY ASSURANCE

A. Provide pneumatic copper tubing for compressed air service located in plenums, walls and MER's.

B. Control Air Damper Performance: Test in accordance with AMCA 500.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by Commissioner.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. General Conditions - Product Requirements: Product storage and handling requirements.

B. Accept controls on site in original factory packaging Inspect for damage.

1.9 COORDINATION

A. Coordinate installation of control components in piping systems with work of Section 23 21 16.

B. Coordinate installation of control components in duct systems with work of Section 23 33 00.

1.10 MAINTENANCE GUARANTEE

A. General Conditions - Execution and Closeout Requirements: Requirements for maintenance service.

B. Furnish service and maintenance of control system for one (1) year from Date of Substantial Completion.

C. Furnish complete service of controls systems, including callbacks. Perform minimum of four (4) complete normal inspections of approximately eight (8) hours duration in addition to normal service calls to inspect, calibrate, and adjust controls. Submit written report after each inspection.

D. Furnish four (4) complete inspections per year to inspect, calibrate, and adjust controls. Submit written report after each inspection.

E. Examine unit components bi-monthly. Clean, adjust, and lubricate equipment.

F. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

G. Perform work without removing units from service during building normal occupied hours.

H. Provide emergency call back service at all hours for this maintenance period.

I. Maintain an adequate stock of parts locally, for replacement or emergency purposes. Ensure personnel availability to ensure fulfillment of this maintenance service without unreasonable loss of time.

J. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

K. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Commissioner.

PART 2 - PRODUCTS

2.1 CONTROL COMPONENT MANUFACTURERS

A. Manufacturers:

1. Honeywell, Building Control Solutions.
2. Johnson Controls, Inc.
3. Siemens Building Technologies, Inc.
4. Automated Logic
5. Substitutions: General Conditions - Product Requirements.

2.2 CONTROL PANEL ENCLOSURES

A. Furnish for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face.

B. Construction: NEMA 250, Type 4 steel stainless steel enclosure.

C. Covers: Continuous hinge, held closed by flush latch operable by key.

D. Enclosure Finish: Manufacturer's standard enamel.

2.3 CONTROL AIR DAMPERS

A. Performance: Test in accordance with AMCA 500.

B. Frames: Galvanized steel [Extruded aluminum] [Stainless steel], welded or riveted with corner reinforcement, minimum 12 gage (2.7 mm) gage.

C. Blades: Galvanized steel [Extruded aluminum] [Stainless steel], one-piece aerofoil blade, maximum blade size 8 inches (200 mm) wide, 48 inches (1200 mm) long, minimum 22 gage (0.85 mm) gage, attached to minimum 1/2 inch (13 mm) shafts with set screws.

D. Blade Seals: Neoprene mechanically attached, field replaceable.

E. Jamb Seals: Stainless steel spring.

F. Shaft Bearings: Lubricant free, stainless steel, single row, ground, flanged, radial, anti-friction type with extended inner race.

G. Linkage Bearings: Oil impregnated sintered bronze.

H. Control Air Damper Leakage: Maximum leakage rate of 3.0 cfm per square foot (0.13 L/s per square meter) at 1.0 inches wg (250 Pa) pressure differential.

I. Maximum Pressure Differential: 6 inches wg (1.5 kPa).

J. Temperature Limits: - 40 to 200 degrees F (-40 to 93 degrees C).

2.4 ELECTRIC DAMPER ACTUATORS

A. Operation: Two-position or Reversing type proportional motor with spring-return as required by operational sequences.

B. Enclosure Rating: NEMA 250 Type 4.

C. Mounting: Direct mount.

D. Stroke: 90 seconds end to end full stroke, 15 seconds return to normal for spring return.

E. Protection: Electronic stall protection.

F. Control Input: 0-10 VDC or2-10 VDC or 0-5 VDC or 4-20 mA.

G. Power: Nominal 24 volt AC.

H. Torque: Size for minimum 150 percent of required duty.

I. Duty cycle: rated for 65,000 cycles.

J. Accessories:

1. Cover mounted transformer.
2. Auxiliary potentiometer.
3. Damper linkage.
4. Direct drive feedback potentiometer.
5. Output position feedback.
6. Field selectable rotational, spring return direction, field adjustable zero and span.
7. End switch.

2.5 CONTROL VALVES

A. All control valves shall be fully proportioning, unless otherwise specified, quiet in operation and shall be arranged to fail safe, in either a normally open or normally closed position, in the event of power or instrument compressed air failure. The open or closed failure position shall be as specified or as required to suit process conditions. All heating valves shall be fail open; all cooling valves shall fail closed. Provisions shall be made for valves operating in sequence, with other valves or dampers, to have adjustable operating ranges and starting points to provide flexibility and adjustment in sequencing and throttling range.

B. Performance Requirements

1. Valves are to be sized and guaranteed to meet the requirements as specified and as indicated on the Drawings.

2. Unless otherwise specified, the following performance requirements shall be used for valve sizing:

a. All control valves shall have a manual override.

b. Flow Rates:

1) Normal flow rate: See equipment schedule on Drawings.

2) Minimum flow rates: 20:1 turndown (or equivalent rangeability) for heat transfer equipment; 5:1 (or equivalent rangeability) turndown for pump discharge throttling and for pressure reducing stations.

3) Maximum flow rate: To be considered only where specified or shown on the Drawings.

c. Pressure Drops:

1) The control valve operator shall be sized to shutoff against a differential pressure equal to the pump design head plus 30%.

2) Flowing pressure drop at design conditions: If not indicated on the drawings or in the Specifications, use 5 psi.

d. Cavitation:

1) Valve selections shall be free of cavitation over the whole range of performance. Obtain relevant upstream pressure for each valve prior to valve selection, and include the documentation for the cavitation check in the shop drawing submittal.

2) All valves will be checked for cavitation and noise during their shop drawing review. If any valve shows light incipient cavitation, it may be accepted, but only after consultation with the Commissioner. Any valve which suffers critical or damaging cavitation shall be replaced by the contractor without extra charge.

e. Ports and Trim:

1) Control valves shall be single-seated and shall have equal percentage or linear flow characteristics.

f. Actuator for control valves shall be electric/electronic type or pneumatic type, as applicable.

C. Globe Pattern:

1. 2 inches (50 mm) and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with back seating capacity packable under pressure.

2. 2-1/2 inches (65 mm) and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.

3. Hydronic Systems:

a. Rate for service pressure of 125 psig at 250 degrees F (860 kPa at 121 degrees C).

b. Replaceable plugs and seats of stainless steel.

c. Sizing: Size for 3 psig (20 kPa) maximum pressure drop at design flow rate.

d. Furnish two-way valves with equal percentage characteristics. Furnish three way valves with linear characteristics. Size two way valve actuators to close valves against pump shut off head.

4. Steam Systems:

   a. Rate for service pressure of 125 psig at 250 degrees F (860 kPa at 121 degrees C).

   b. Replaceable plugs and seats of stainless steel.

   c. Sizing: Pressure drop across steam valve at maximum flow as indicated on Drawings.

   d. Sizing: Pressure drop across steam valve equal to maximum flow of 80 percent of inlet steam pressure for low-pressure systems and 42 percent for high-pressure systems.

   e. Furnish valves with modified linear characteristics.

D. Ball Valves:

1. Threaded ends for 2-way valves 3 inches (76 mm) and smaller. Threaded ends for 3-way valves 2 inches (50 mm) and smaller.

2. Forged brass body, chrome plated brass ball and blowout proof stem and EPDM O-rings with minimum 600 psig (4135 kPa) rating.

3. Fluid Temperature Range: minus 20 to 250 degrees F (minus 29 to 121 degrees C).

4. Sizing: 3 psig (20 kPa) maximum pressure drop at design flow rate.

5. Isolation service: Full port, line sized.

6. Flow Characteristics: Furnish 2-way valves with equal percentage characteristics. Furnish 3-way valves with equal percentage characteristic through control port and linear characteristic through bypass port.

7. Size 2-way valve actuators to close valves against pump shut off head.

E. Butterfly Valves:

1. Service Pressure Rating: 125 psig at 250 degrees F (860 kPa at 121 degrees C).

2. Construction: ASTM A126 cast-iron or ASTM A536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.

3. Body Style: Wafer, or Lug.

4. Disc: Stainless steel.

5. Resilient replaceable seat for service to 250 degrees F (121°).

   a. Size for 1 psig (7 kPa) maximum pressure drop at design flow rate.

6. Use only for open-close two-position operation.

F. Terminal Unit Control Valves:

1. Brass body, Class 250, nickel plated brass ball, with optimizer insert for modulating applications, blow out resistant stem, threaded ends.

2. Two or three way as indicated in schedule or on Drawings.

3. Integral actuator.

4. Spring return required for unit ventilator heating valves and other terminal equipment with outside air.

5. Furnish non-spring return valves with manual override capability built into actuator.

6. Minimum Fluid Temperature: 20 degrees F (minus 7 degrees C).

7. Maximum Operating Conditions: 250 degrees F (121 degrees C).

8. Sizing: 3 psig (21 kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.

9. Flow Characteristics: Furnish two-way and three-way valves with equal percentage characteristics.

G. Characterized Control Valves:

1. Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of the piping system, unless otherwise indicated.

2. Pressure Independent Control Valves

   a. Manufacturers:

      1) Belimo Aircontrols (USA), Inc.

2) Flow Control Industries

3) Siemens

4) Approved equal

b. The modulating control valves shall be pressure independent.

c. The control valves shall accurately control the flow from 0 to 100% full rated flow with an equal percentage flow characteristic. The flow shall not vary more than ± 5% due to system pressure fluctuations across the valve with a minimum of 5 PSID across the valve.

d. Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and TEFZEL characterizing disc.

e. Combination of actuator and valve shall provide a minimum close-off pressure rating of 200 PSID.

f. The control valve shall require no maintenance and shall not include replaceable cartridges.

g. All actuators shall be electronically programmed by use of a handheld programming device or external computer software. Programming using actuator mounted switches or multi-turn actuators are NOT acceptable. Actuators for 3-wire floating (tri-state) on 1/2 inch – 1 inch pressure independent control valves shall fill in place and have a mechanical device inserted between the valve and the actuator for the adjustment of flow. Actuators shall be provided with an auxiliary switch to prove valve position.

h. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory via a single screw on a four-way DIN mounting base.

i. The control valve shall require no maintenance and shall not include replaceable cartridges.

j. The manufacture shall warrant all components for a period of 5 years from the date of acceptance, with the first two years unconditional.

k. The use of pressure independent valves piped in parallel to achieve the rated coil flow shall be permitted. Actuators shall be electronically programmed to permit sequencing the flow with a single control output point. The use of external devices to permit sequencing is NOT acceptable.

2.6 ELECTRIC VALVE ACTUATORS

A. Fully factory assembled. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action under every condition.

B. Motor: Permanent split-capacitor or shaded-pole type. Gear trains completely oil immersed and sealed. Furnish spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

C. Actuator: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. Furnish actuator with rating of not less than twice thrust needed for actual operation of valve.

1. Coupling: V-bolt and V-shaped, toothed cradle.

2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

3. Fail-Safe Operation: Mechanical, spring-return mechanism. Furnish external, manual gear release on non-spring-return actuators.

4. Furnish spring-return actuators with manual override. Complete manual override to take no more than 10 turns.

5. Power Requirements:

a. Two-Position Spring Return: 24 volt AC or DC, maximum 10 vA.

b. Modulating: 24 volt AC, maximum 15 vA.

6. Proportional Signal: 2 to 10 volt dc or 4 to 20 mA, and 2 to 10 volt dc position feedback signal.

7. Temperature Rating: minus 22 to 140 degrees F (minus 30 to 60 degrees C).

8. Run Time: 200 seconds open, 40 seconds closed.

D. Size for torque required for valve close-off at maximum pump differential pressure, regardless of water loop system pressures.

2.7 OUTSIDE AIR MEASURING AND MODULATION DEVICE

A. Factory assembled damper, airflow monitor, actuator, and accessories.

B. Damper and airflow measurement assembly sized to accommodate minimum outside airflow as indicated on Drawings.

C. Construction:

1. Frame: Extruded aluminum.

2. Blades:

a. Modulating Air Control:

1) Style: Airfoil-shaped, single-piece.

2) Action: Opposed.

3) Orientation: Horizontal.

4) Material: Heavy gage 6063-T5 extruded aluminum.

5) Width: Maximum 5 inches (127 mm).

b. Stationary Sensing:

1) Style: Airfoil-shaped, single-piece.

2) Orientation: Horizontal.

3) Material: Heavy gage 6063-T5 extruded aluminum.

4) Width: Maximum 5-1/4 inches (133 mm).

5) Finish: Anodized.

3. Bearings: Self-lubricating molded synthetic sleeve, turning in extruded hole in frame.

4. Seals:

a. Blade: Extruded rubber. Mechanically attached to blade edge.

b. Jamb: Stainless steel, flexible metal compression type.

c. Linkage: Concealed in frame.

d. Axles: Minimum 1/2 inch (13 mm) diameter plated steel, hex-shaped, mechanically attached to blade.

e. Mounting: Vertical.

f. Electric Actuator: 24 V, 60 Hz, modulating, with position feedback.

5. Digital Controller: Application specific controller. Programming logic and calibration in nonvolatile EPROM. Controller uses generic 0 - 10 vdc inputs and outputs for interface to building automation system.

6. Air Straightener Section: 3 inches (76 mm) deep section contained in 5 inch (127 mm) long sleeve attached to damper-airflow monitor frame.

7. Finish: Mill aluminum.

D. Performance Data:

1. Temperature Rating: Withstand -40 to 140 degrees F (-40 to 60 degrees C).

2. Accuracy: Plus or minus 5 percent.

3. Leakage: Maximum of 2 cfm per square foot at 1.0 inches wg (250 Pa) pressure differential.

4. Measures from 15 percent to 100 percent of unit nominal air flow.

5. Adjusts air flow for temperature variations.

6. Provides 2 to 10 volt DC signal corresponding to actual air flow.

E. Accessories:

1. Actuator Heater: Allow actuator operation in ambient temperatures to -40 degrees F (-40 degrees C).

2.8 AIR FLOW MONITORING STATIONS

A. Fan Inlet Airflow Traverse Probes:

1. Where required on the drawings, provide airflow traverse probes mounted in the fan inlets capable of continuously measuring the air

handling capacity (air volume) of the respective centrifugal or vane-axial fan(s).

2. The fan inlet airflow traverse probes shall contain multiple total and static pressure sensors placed at concentric area centers along the exterior surface of the cylindrical probe and internally connected to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the probe, nor be adversely affected by particle contamination normally present in building system airflows.

3. The fan inlet airflow traverse probes (two per inlet) shall have dual end support swivel brackets suitable for mounting in the fan inlet bell and symmetrical averaging signal takeoffs and fittings, and shall be of stainless steel construction.

4. The fan inlet airflow traverse probes shall not induce a measurable pressure drop, nor shall the sound level within the system be amplified by its presence in the fan inlet bell. The probes shall be capable of producing steady, non-pulsating signals of standard total and static pressure, without need for flow corrections or factors, with an accuracy of 3% of actual flow over a fan operating range of 6 to 1 capacity turndown. The probes shall be suitable for 10,000 fpm operation.

B. Air flow measuring stations shall be provided at points indicated on the mechanical drawings or control diagrams, or required by sequences of operation, with careful attention paid to upstream and downstream straight run requirements for proper installation. Vendor requirements for AMU installation shall be carefully followed.

C. Each air flow measuring station shall be fabricated of a heavy gauge galvanized steel casing with 90 degree connecting flanges in a configuration and size approximating that of the duct or opening in which it is to be mounted. Each station shall be complete with aluminum flow straightener, copper symmetrical total and static pressure sensors and self-averaging manifolds, internal piping, and external pressure transmission ports with flexible tubing and quick-connect fittings. An identification label shall be placed on each station casing, listing model No., size, area, design flow, and differential pressure at design flow.

D. The maximum allowable pressure loss through the station shall not exceed 0.05 inches w.g. at 1500 fpm, or 0.20 inches w.g. at 3000 fpm. The sound level within the duct shall not be amplified (nor shall additional sound be generated by the air measuring unit). Each station shall be capable of measuring the airflow rate within an accuracy of 2% as

determined by U.S. - G.S.A. Certification Tests, and shall contain a minimum of one total pressure sensor per 36 square inches of station measuring area.

E. Each air flow measuring station shall be furnished with an electronic differential pressure transmitter capable of transmitting a 4 to 20 mA DC output signal. Accuracy shall be $\pm$0.5% of span including linearity, hysteresis and repeatability. Repeatability shall be $\pm$0.05% of span. Each transmitter shall have a 1" x 2" stainless steel tag permanently attached with screws with the tag number, design flow, and the differential pressure at design flow permanently engraved on its surface.

F. Each air flow measuring station shall be furnished with a local differential pressure gage calibrated to full range with graduations in both inches W.C. and in CFM. Dwyer magnehelic 2000 series.

G. Static Pressure Sensors/Transmitters - Air Side:

1. Duct static pressure sensors shall consist of a sensing tube, transmitter and electrical box for wiring connections.

2. Two wire transmitter shall provide 4-20 mA DC output linear over specified pressure range.

3. Wiring connections shall accept 16 AWG wire.

4. Calibrated end to end accuracy shall be $\pm$0.25% of full range, including linearity, hysteresis, and repeatability.

H. Airflow Pressurization Control Centers:

1. The Contractor may either integrate the "Air Flow Pressurization Controls" into the DDC system or purchase control centers from approved vendors below for dedicated operation of these systems.

2. Individual airflow and pressurization control centers shall be provided for air handling system AC-7 and located in the MER.

3. Metal cabinets suitable for wall mounting shall be provided for mounting the control equipment. Each individual cabinet shall be provided with a hinged-front access door not over 30" wide with flush latch handle and key-locking means, and be constructed of steel not lighter than #14 U.S. Gauge. Cabinet door shall contain a clear plastic panel to permit viewing the control module(s) operating status without need to enter cabinet.

4. All control instruments, devices, relays, etc., shall be contained within the cabinet and installed for servicing from the front of the cabinet with door open.

5. All wiring and tubing connections to control instruments, devices, etc., shall be made inside the cabinet, and numbered and color coded for identification. External ports shall be provided at the bottom or side of the control cabinet for the connection or entry of signal tubing, control wiring or power supply.

6. Engraved nameplates, permanently screwed in place, shall be provided for all indicating devices. Painting of nameplates directly on the panel or gluing on plastic, paper, embossed, or printed letters is not acceptable.

7. Airflow control centers shall include all transmitters, square root extractors, multipliers, three-mode controllers, relays, and control devices required to maintain the airflow conditions and pressurization levels detailed on the drawings or specified therein. All of the control instruments shall be of the card type suitable for rack mounting, and shall be installed in the rack with required signal tubing to the cabinet bulkhead fittings and electrical connections to internal marked terminal strips.

8. Each transmitter, square root extractor, multiplier, and controller shall be provided with test terminals to permit the temporary installation of electronic meters to facilitate signal readouts during start-up adjustments and servicing.

9. Digital displays shall be provided for continuous indication of each of the controlled processes (air volume, duct or system static pressure, room pressure level). Each digital display shall contain a minimum of four 1/2" high digits, scaled to indicate in the process measurement (CFM, IN w.c.), and shall be flush-mounted on the front of the control center.

10. Each airflow control center shall be provided with its own power converter system capable of operating the center on the available power supply (120 VAC, 24 VAC, etc.). Separate terminals shall be provided for power connections, for analog signals for remote indication stations and computer data logging, and for actuator control signals.

11. Where signal interface with a building automation system or central computer for data logging and/or supervisory control is required,

provide all necessary output and input signal interface modules, each with line isolators.

I. Outdoor Air Monitoring Systems:

1. General:

a. The outside air flow measuring system shall be capable of measuring outdoor at low velocities.

2. Outdoor Air Flow/Temperature Measurement Devices:

a. Each ATMD shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor assemblies.

1) Each sensor assembly shall contain two individually wired, hermetically sealed bead-in-glass thermistors.

2) Thermistors shall be mounted in the sensor assembly using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment.

3) The airflow rate of each sensor assembly shall be equally weighted and averaged by the transmitter prior to output.

4) The temperature of each sensor assembly shall be velocity weighted and averaged by the transmitter prior to output.

5) Each transmitter shall have a 16-character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics.

6) Devices using chip-in-glass or diode-case chip thermistors are not acceptable.

7) Devices using less than two thermistors in each sensor assembly are not acceptable.

8) Devices using platinum wire RTDs are not acceptable.

9) Devices having electronic circuitry mounted in or at the sensor probe are not acceptable.

10) Pitot tubes and arrays are not acceptable.

11) Vortex shedding devices are not acceptable.

3. All Sensor Probes:

a. Each sensor assembly shall independently determine the airflow rate and temperature at each measurement point.

b. Each sensor assembly shall be calibrated at a minimum of 16 airflow rates and 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST).

c. Airflow accuracy shall be +/-2% of Reading over the entire operating airflow range.

1) Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.

d. Temperature accuracy shall be +/-0.15°F over the entire operating temperature range of -20°F to 160°F.

e. The operating humidity range for each sensor probe shall be 0-99% RH (non-condensing).

f. Each sensor probe shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.

g. Each sensor assembly shall not require matching to the transmitter in the field.

h. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter for each measurement location.

4. Duct And Plenum Probes:

   a. Probes shall be constructed of extruded, gold anodized, 6063 aluminum tube. All wires within the aluminum tube shall be Kynar coated.

   b. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:

      1) Insertion mounted through the side or top of the duct

      2) Internally mounted inside the duct or plenum

      3) Standoff mounted inside the plenum

   c. The number of sensor housings provided for each location shall be as follows:

Duct or Plenum Area (sq.ft.)	Total # Sensors / Location
<2	4
2 to < 4	6
4 to < 8	8
8 to <16	12
>=16	16

   d. The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.

5. Transmitters:

   a. The transmitter shall have an integral LCD display capable of simultaneously displaying airflow and temperature. The LCD display shall be capable of displaying individual airflow and temperature readings of each independent sensor assembly.

   b. The transmitter shall be capable of field configuration and diagnostics using an on-board pushbutton interface and LCD display.

   c. The transmitter shall have a power switch and operate on 24 VAC (isolation not required).

1) The transmitter shall use a switching power supply fused and protected from transients and power surges.

2) The transmitter shall use "watch-dog" circuitry to assure reset after power disruption, transients and brown-outs.

d. All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.

e. The operating temperature range for the transmitter shall be -20°F to 120°F. The transmitter shall be installed at a location that is protected from weather and water.

f. The transmitter shall be capable of communicating using the following interface:

1) Linear analog output signals for airflow and temperature: Field selectable, fuse protected and isolated, 0-10VDC/4-20mA (4-wire)

6. Installation:

a. Install airflow/temperature measurement devices in accordance with manufacturer's instructions at the locations indicated on the plans.

b. The mounting of the outdoor air probes shall be coordinated with the sheet metal contractor, in accordance with the manufacturer's recommendations.

c. A written report shall be submitted to the Commissioner confirming that the probes are installed in accordance with the manufacturer's recommendations.

d. Install electronic cables according to Division 16 requirements.

e. Install low-voltage power, signal and communication cable according to Division 16 requirements.

7. Adjusting:

a. Duct and plenum devices shall not be adjusted without approval from the Commissioner.

8. Acceptable Manufacturers:

   a. Subject to compliance with requirements of this Section, provide products that comply with this specification by one of the following vendors:

      1) EBTRON, Inc. Model GTx116-P

      2) Kurz Instruments

      3) Fluid Components International (FCI)

      4) Air Monitor

2.9 INDOOR AIR QUALITY (CO_2) SENSORS

A. Provide indoor air quality sensors to monitor Carbon Dioxide (CO_2).

B. The sensors shall be of microprocessor-based photoacoustic type with heated stannic dioxide semiconductor.

C. The CO_2 sensors shall have no more than 1% drift during the first year of operation and minimal drift thereafter so that no calibration will be required.

D. The units shall be wall or duct mounted type as indicated on plans and in the sequence of operation.

E. Wall mounted sensors shall be provided with plastic cover whose color is approved by the Commissioner, without LED indicators.

F. Duct mounted sensors shall be provided with LED indicators in a dust proof plastic housing with transparent cover.

G. accuracy.

H. The sensor shall meet the following requirements:

Operating voltage:	24 VAC +/- 20%
Frequency:	50/60 Hz
Power consumption:	max. 6 VA
CO2 measuring range:	0 – 2000 ppm
Tolerance:	+/- 100 ppm
Output:	0 – 10 VAC or 4-20mA
Calibration:	none required
Permissible air velocity in duct:	<26.2 Ft/s.

I. The sensors shall be model: Siemens QPA Series or approved equivalent.

2.10 RELAYS

A. Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

B. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

2.11 VOLTAGE TRANSFORMERS

A. AC voltage transformers shall be UL/CSA Recognized, 600 VAC rated, complete with built-in fuse protection.

B. Transformers shall be suitable for ambient temperatures of 4°C to 55°C (40°F to 130°F) and shall provide ±0.5% accuracy at 24 VAC and a 5 VA load.

C. Windings (except for terminals) shall be completely enclosed with metal or plastic material.

2.12 DIRECT DIGITAL CONTROL SYSTEM COMPONENTS

A. Temperature Sensors:

1. Type: Resistance temperature detector (RTD) or thermistor.

2. Accuracy:

a. ±1°F for standard applications. Where high accuracy is required, furnish accuracy of plus or minus 0.2°F.

b. Sensing Accuracy: ±0.5°F.

c. Display Accuracy and Resolution: Minimum of plus or minus 1°F.

3. Built-in communications port.

4. Space Sensors: withoutset point adjustment capability.

5. Outside Air Sensors: Watertight inlet fitting, furnish with shield from direct sunlight.

6. Duct Temperature Sensors:

a. Rigid or averaging type as indicated in sequence of operations. Averaging sensor minimum length: 5 feet (1.5 meters) in length.

b. Duct Cross Sections Greater Than 10 square feet (0.9 square meters): Furnish serpentine averaging element to sense stratified air temperatures.

7. Piping Temperature Sensors: Furnish with separable brass well.

8. Liquid immersion temperature:

Temperature monitoring range	+30/250°F (-1°/121°C)
Output signal	Changing resistance
Accuracy at Calibration point	±0.5°F (+/-0.3°C)

9. Duct (single point) temperature:

Temperature monitoring range	+20/120°F (-7°/49°C)
Output signal	Changing resistance
Accuracy at Calibration point	±0.5°F (+/-0.3°C)

10. Duct Average temperature:

Temperature monitoring range	+20° ±120°F(-7°/+49°C)
Output signal	4 – 20 mA DC
Accuracy at Calibration point	±0.5°F (±03°C)
Sensor Probe Length	25' L (7.3m)

11. Boiler Stack Temperature Sensor:

a. Immersion type with ½" NPT threading

b. High temperature grade 304 stainless probe

c. Temperature span 0 to 800 deg F

B. Humidity Sensors:

1. Type: Capacitance or bulk polymer resistance.

2. Drift: Not to exceed 3 percent of full scale per year.

3. Duct Sensors:

a. Sensing Range: 0 to 100 percent.

b. Accuracy of plus or minus 2 percent relative humidity.

c. Furnish with sampling chamber.

d. Element guard.

e. Mounting plate.

4. Outdoor Air Humidity Sensors:

a. Sensing Range: 20 to 95 percent relative humidity.

b. Suitable for ambient conditions of minus 40 to 170 degrees F (minus 40 to 77 degrees C).

c. Accuracy: Plus or minus 2 percent relative humidity at 77 degrees F (25 degrees C).

d. Element guard.

e. Mounting plate.

C. Differential Pressure Switches:

1. Furnish as specified in sequences of operation for status purposes in air and water applications.

2. Fully adjustable differential pressure settings.

3. UL Listed, SPDT snap-acting, pilot duty rated (125 VA minimum).

4. NEMA 250 Type 1 enclosure.

5. Scale range and differential suitable for intended application.

D. Static Pressure Sensor:

1. Non-directional sensor with suitable range for expected input, and temperature compensated.

2. Accuracy: plus or minus 1 percent of full scale with repeatability of 0.5 percent.

3. Output: 4 to 20 mA, 0-5 vDC, 0-10 vDC, 2-10vDC.

4. Building Static Pressure Range: minus 0.1 to 0.1 inches water column (minus 25 to 25 Pa), minus 0.25 to 0.25 inches water column (minus 60 to 60 Pa), minus 0.5 to 0.5 inches water column

(minus 125 to 125 Pa), minus 1.0 to 1.0 inches water column (minus 250 to 250 Pa), jumper selectable.

5. Duct Static Pressure Range: 0 to 1 inches water column (0 to 250 Pa), 0 to 2.5 inches water column (0 to 620 Pa), 0 to 5 inches water column (0 to 1,245 Pa), 0 to 10 inches water column (0 to 2,490 Pa), jumper adjustable.

E. Liquid Differential Pressure Transmitter:

Ranges	0-5/30 inches H20 0-25/150 inches H20 0-125/750 inches H20
Output	4 – 20 mA DC
Calibration Adjustments	Zero and span
Accuracy	±-0.2% of span
Linearity	±-0.1% of span
Hysteresis	±-0.05% of span

F. Static Pressure Sensors:

1. Differential pressure type.

2. Sensor range closely matched to system static pressure, minus 0.5 to 0.5 inches water column (minus 125 to 125 Pa), minus 1 to 1 inches water column (minus 250 to 250 Pa) or 0 to 2.5 inches water column (0 to 620 Pa).

3. Accuracy: Plus or minus 5 percent of sensing range.

G. Carbon Dioxide Sensors:

1. Sensors designed for indoor carbon dioxide levels in accordance with ASHRAE Standard 62.

2. 4 to 20 ma. linear output over range of 0 to 2000 ppm (0 to 2000 mg/kg) of carbon dioxide for interface to DDC control system.

3. For duct mounted sensors furnish airtight enclosure complete with sampling tube.

H. Air Flow Switches:

1. Paddle or differential pressure type, as indicated in sequences of operation.

2. UL Listed, SPDT snap-acting with pilot duty rating (125 VA minimum).

3. Appropriate scale range and differential adjustment.

4. Adjustable sensitivity.

5. NEMA 250 Type 1 enclosure.

I. Water Flow Switches:

1. Paddle type with stainless steel or bronze paddle.

2. UL Listed, SPDT snap-acting with pilot duty rating (125 VA minimum).

3. Appropriate scale range and differential adjustment.

4. Adjustable sensitivity.

5. NEMA 250 Type 1 enclosure.

6. Furnish vapor proof type for chilled water applications.

J. Carbon Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23 to 130 degrees F (minus 5 to 54 degrees C), calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.

K. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180 degree field of view with vertical sensing adjustment, for flush mounting.

L. Flow Measurement - Waterside

1. Acceptable Manufacturers:

a. Subject to compliance with requirements of this Section, provide products that comply with this specification by one of the following vendors:

1) Onicon

2) Emerson-Rosemount

3) Siemens Sitrans

4) Approved equal

b. The flow measurement system shall run on a 115 VAC power source.

c. Accuracy shall be ± 0.25% of actual value. Linearity shall be ± 0.1% of actual value. Rangeability: 100 - 1.

d. Output shall be 4-20mA DC linear over calibrated range.

e. The flow measurement system shall be in accordance with the P&ID's.

2. Straight Run Requirements:

a. Manufacturer's recommendations shall be carefully adhered to with respect to straight run requirements to obtain specified accuracies.

b. Submit for approval, location of flow elements in piping clearly indicating upstream and downstream straight run dimensions.

3. Tagging:

a. Each flow element shall have a 1" x 2" stainless steel tag either permanently attached with screws or attached with a six inch chain.

b. The stainless steel tag shall have the tag number, design flow, and, when applicable, the differential pressure at design flow permanently engraved on its surface.

M. Freezestats:

1. Install freezestats for each hot water coil and provide protection for every square foot of coil surface area with one linear foot of element.

2. Upon detection of low temperature, the freezestats shall stop the associated supply fans and return the automatic dampers to their normal position. Provide manual reset.

3. Low limit freeze protection thermostats shall have 20' low point sensitive elements (not averaging type) installed to cover the entire coil face area. The elements shall be suspended at least 12" to 15" downstream of the preheater coil. these thermostats shall be 24 volt, two-position, manually reset type. Provide multiple freeze-stats to cover entire face of multi-coil banks. Every 20 square feet of coil requires one freeze-stat as minimum. Freezestats shall be hard wired.

N. Current Sensing Relay:

1. Provide solid-state, split-core, adjustable, current operated relay. Provide a relay which changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.

2. Adjust the relay switch point so that the relay responds to motor operation under load as an "on" state and so that the relay responds to an unloaded running motor as an "off" state. A motor with a broken belt is considered an unloaded motor.

3. Provide status device for all fans and pumps.

O. Pressure Transmitter - Water Side:

1. Transmitter shall provide a 4-20 ma DC output signal linear over calibrated pressure range.

2. Transmitter shall have the capability to adjust zero and span externally over the full range of the instrument.

3. Transmitter shall be capable of operating from -20°F to +180°F and from 0 to 100%RH. Temperature effect shall be $\pm$1.0% of span per 100°F.

4. Transmitter shall be capable of withstanding pressures up to 1000 psig without damage to the instrument.

5. Stability shall be $\pm$0.25% of upper range limit for six months.

6. Accuracy (including linearity, repeatability, and hysteresis) shall be $\pm$0.25% of calibrated span.

7. Transmitter shall be capable to be pipe or panel mounted in any position with no effect upon operation.

8. Transmitter shall be furnished with flat mounting bracket for vertical mounting to a 2 inch pipe stand and drain/vent valve applicable for service conditions.

P. Differential Pressure Transmitter - Water Side:

1. Transmitter shall provide a 4-20 ma DC output signal linear over calibrated pressure range.

2. Transmitter shall have the capability to adjust zero and span externally over the full range of the instrument.

3. Transmitter shall be capable of operating from -20°F to +180°F and from 0 to 100%RH. Temperature effect shall be ±1.0% of span per 100°F.

4. Transmitter shall be capable of withstanding pressures ranging from 0 psig to 2000 psig on either side without damage to the instrument.

5. Stability shall be ±0.25% of upper range limit for six months.

6. Accuracy (including linearity, repeatability, and hysteresis) shall be ±0.20% of calibrated span. Linearity shall be ±0.1% of span; hysteresis shall be ±0.05% of span.

7. Transmitter shall be capable to be pipe or panel mounted in any position with no effect upon operation.

8. Transmitter shall be furnished with flat mounting bracket for vertical mounting to a 2 inch pipe stand and drain/vent valve applicable for service conditions.

Q. Temperature Transmitter - Water Side:

1. Transmitter shall provide a 4-20 ma DC output signal linear over calibrated temperature range.

2. Transmitter shall have the capability to adjust zero and span externally over the full range of the instrument.

3. Transmitter shall be capable of operating from -25°C to +85°C.

4. Transmitter output shall fail upscale on loss of sensor input.

5. Stability shall be ±0.20% of calibrated span for six months.

6. Accuracy (including linearity, repeatability, and hysteresis) shall be ±0.20% of calibrated span.

7. Transmitter shall be furnished with mounting bracket for mounting to a 2 inch pipe stand. Transmitter shall be capable to be pipe or panel mounted in any position with no effect upon operation.

8. Transmitter to be furnished complete with integrally mounted 100 Ohm Platinum RTD sensor.

2.13 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with Section 26 05 03.

B. Motors: In accordance with Section 23 05 13.

C. Disconnect Switch: Factory mount disconnect switch on equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General Conditions - Administrative Requirements: Coordination and project conditions.

B. Verify condition of air handling units and ductwork.

C. Verify location of exposed, space-mounted control sensors with Drawings before installation.

3.2 INSTALLATION

A. Install sleeves through concrete surfaces in minimum one inch sleeves.

B. Install space temperature sensors, C02 sensors and other exposed, space-mounted control sensors after locations are coordinated with other Work, and such that sensors are aligned with other new and existing devices. In the absence of existing control devices, install new sensors 60 inches above finished floor.

C. Install outdoor air temperature sensors, with sun shield over sensing elements, and per manufacturer's recommendation.

D. Install control panels adjacent to associated equipment on vibration free walls or freestanding supports as indicated on drawings. Use one cabinet for each system. Install engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face. Label with appropriate equipment or system designation as indicated on equipment schedules.

E. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

F. Install conduit, boxes and electrical wiring, etc. in accordance with Section 26 05 03.

3.3 ELECTRICAL WIRING AND MATERIALS

A. Install, connect and wire the items included under this Section and all other Sections of HVAC work. This work includes providing required conduit, wire, fittings, backboxes, transformers and related wiring accessories. All conduit, wiring and accessories shall be installed in accordance with Division 26 Specifications.

B. Provide 120 volt, single phase, 60 hertz emergency power to every B.M.S. DDC Controller panel, HVAC/Mechanical Equipment Controller, PC console, power supply, transformer, modems, printers, and to other devices as required.

C. HVAC contractor shall provide all 120 volt to 24 volt transformers and wiring to each VAV box, controller, etc.

D. Provide all conduit and wiring for boiler system controls, chiller controls, AC unit controls, BMS system and accessories, etc. as shown on the drawings, and as required for a complete and operational system.

E. Provide electrical wall box and conduits for all wall mounted devices.

F. All wiring to be compliant to local building code and the NEC.

3.4 FIELD QUALITY CONTROL

A. General Conditions - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

3.5 DEMONSTRATION AND TRAINING

A. General Conditions - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate complete operation of systems, including sequence of operation prior to Date of Substantial Completion.

C. Demonstrate complete and operating system to the Commissioner.

END OF SECTION

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SECTION 23 09 23

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control equipment and software.

B. Related Sections:

1. Section 23 09 00 - Instrumentation and Control for HVAC: Control system components.
2. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
3. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI MC85.1 - Terminology for Automatic Control.
2. ANSI/ASHRAE Standard 135 – BACNET – A Data Communication Protocol for Building Automation and Control Networks.

1.3 SYSTEM DESCRIPTION

A. Automatic temperature controls field monitoring and control system using field programmable microprocessor based units with communications to Building Automation and Control System.

B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.

C. Provide computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

D. Provide controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and when directly connected to control units. Individual terminal unit control is specified in Section 23 09 00.

E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories to operate mechanical systems, and to perform functions specified.

F. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

G. The entire system shall be UL 864 listed for smoke control operation and meet all NYCBC requirements for smoke exhaust.

1.4 SUBMITTALS

A. General Conditions - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate the following:

1. Trunk cable schematic showing programmable control-unit locations and trunk data conductors.

2. System schematics, including:

a. sequence of operations

3. system riser diagrams

4. Connected data points, including connected control unit and input device.

5. System graphics showing monitored systems, data connected and calculated point addresses, and operator notations.

6. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

7. Description and sequence of operation for operating, user, and application software.

8. Use terminology in submittals conforming to ASME MC85.1.

9. Coordinate submittals with information requested in Section 23 09 93.

10. Submit BACNET system architecture drawings and BACNET compliant devices.

C. Product Data: Submit data for each system component and software module.

D. Manufacturer's Installation Instructions: Submit installation instruction for each control system component.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. General Conditions - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.

1. Revise shop drawings to reflect actual installation and operating sequences.

2. Indicate drawing submittal pages "As-Built Drawings" with date of associated changes.

3. Submit data specified in "Submittals" in final "Record Documents" form.

C. Operation and Maintenance Data:

1. Submit interconnection wiring diagrams complete field installed systems with identified and numbered system components and devices.

2. Submit keyboard illustrations and step-by-step procedures indexed for each operator function.

3. Submit inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.6 QUALITY ASSURANCE

A. The BAS system shall be designed and installed, commissioned and serviced by a manufacturer-employed, factory-trained personnel. Manufacturer shall have an in-place support facility with technical staff, spare parts inventory and necessary test and diagnostic equipment.

The manufacturer shall provide an on-site, experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the Building Automation System (BAS).

The Contractor shall be regularly engaged in the manufacturing, installation and maintenance of BAS systems and shall have a minimum of three (3) years of demonstrated technical expertise and experience in the manufacture, installation and maintenance of BAS systems similar in size and complexity to this project. A maintained service organization consisting of competent servicemen and provide a list of projects, similar in size and scope to this project, completed within the last five years.

B. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

C. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX; Standard ULC C100, category UUKL7; and under Standard UL 864, categories UUKL, UDTZ, and QVAX, and be so listed at the time of bid. All floor level controllers shall comply, at a minimum, with UL Standard UL 91 6category PAZX; Standard UL 864, categories UDTZ, and QVAX and be so listed at the time of Bid. The purpose of the regulation is to minimize electromagnetic interference between electronic products, which may diminish the performance of electrical products or disrupt essential communications.

D. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

E. The manufacturer of the building automation system shall be in compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.

F. This system shall have a documented history of compatibility by design. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field

panels to current level of technology, and extend new field panels on a previously installed network.

G. Compatibility shall be defined as the ability for any existing field panel microprocessor to be connected and directly communicate with new field panels

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 MAINTENANCE GUARANTEE

A. Furnish service and maintenance of control systems for one (1) year from Date of Substantial Completion.

B. Furnish complete service of controls systems, including callbacks. Make minimum of 4 complete normal inspections of approximately 8 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls. Submit written report after each inspection.

C. Furnish four (4) complete inspections per year, one in each season, to inspect, calibrate, and adjust controls. Submit written report after each inspection.

D. Examine unit components bi-monthly. Clean, adjust, and lubricate equipment.

E. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.

F. Perform work without removing units from service during building normal occupied hours.

G. Provide emergency call back service during working hours for this maintenance period.

H. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

I. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

1.10 EXTRA MATERIALS

A. Furnish two printer ink cartridges for each type of supported color and cartons of printer paper.

PART 2 - PRODUCTS

2.1 DIRECT DIGITAL CONTROLS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products may be incorporated into the project:

1. Honeywell

B. Furnish materials in accordance with NYCBC.

2.2 SERVER AND OPERATOR WORKSTATION

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Dell

2. HP

3. Lenovo

4. Approved equal

B. Furnish materials in accordance with NYCBC.

C. Furnish each operator workstation and server consisting of the following:

D. Server: IBM Tower PC compatible with sufficient memory and hard drive storage to support graphics, reports, and communication requirements:

1. Processor: Intel Xeon E5 or faster

2. RAID 5 Backup
3. Hard Drive: SAS Type 1TB or greater to support RAID 5
4. Memory: 16 Gigabyte DIMM memory.
5. Drive 1: 48x CD Burner, DVD combination.
6. Ports: Required serial, parallel, network communications, USB, and cables for proper system operation.
7. Expansion Slots, standard typical with server
8. LAN Card: Gigabit Ethernet
9. Mouse: two-button optical type [wireless]
10. Keyboard: 104 key.

E. Personal Computer: Furnish with the following minimum configuration requirements:

1. Processor: Intel Core i7
2. Hard Drive: 320 Gigabyte.
3. Memory: 8 Gigabyte DIMM memory.
4. Drive 1: 48x CD Burner, DVD combination.
5. Drive 2: 16x DVD-ROM, DVD combination.
6. Ports: Required serial, parallel, network communications, USB, and cables for proper system operation.
7. Expansion Slots: 1 used for LAN card, 1 available.
8. LAN Card: Gigabit Ethernet
9. Mouse: two-button optical type [wireless].
10. Keyboard: 104 key.

F. Monitor: Minimum of 24 inch color, flat panel LCD display; one for the server and one for the operator station.

G. Operating System: Windows 7 or latest.

H. Printer: Furnish operator workstation with laser printer and associated cables. Printer capable of minimum of 25 pages per minute (PPM)

operation and compatible with standard parallel or USB communications or network capable.

I. Impact Printer: Furnish operator workstation with impact printer. Printer shall be 24-pin, impact dot matrix, Minimum 110 cps for letter quality print.

J. Network switch: Cisco based 8-port Ethernet switch

K. System Support: Minimum ten (10) work stations connected to multi-user, multi-tasking environment with concurrent capability to:

1. Access DDC network.

2. Access or control same control unit.

3. Access or modify same control unit database.

4. Archive data, alarms, and network actions to hard disk regardless of what application programs are being currently executed.

5. Develop and edit database.

6. Implement and tune DDC control.

7. Develop graphics.

8. Control facility.

2.3 PORTABLE OPERATOR'S TERMINAL

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Dell Corporation.

2. HP

3. Lenovo

B. Furnish device capable of accessing system data and capable of being connected to any point on system network or connected directly to any controller for programming, set-up, and troubleshooting. Portable Operators Terminal uses Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135, to communicate with BACnet objects in internetwork. Objects supported

include: Analog input, analog output, analog value, binary input, binary output, binary value, device.

C. Furnish IBM compatible notebook-style PC including software and hardware required with:

1. Processor: Intel core i7
2. Hard Drive: 160 Gigabyte or greater.
3. Memory: 4 Gigabyte DDR SDRAM.
4. Lithium ion Battery
5. LAN Card: Wireless 802.11n and onboard Ethernet(100 base-T)

2.4 CONTROL UNITS

A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment located in NEMA 4 enclosures.

B. Battery Backup: For minimum of 100 hours for complete system including RAM without interruption, with automatic battery charger.

C. Control Units Functions:

1. Monitor or control each input/output point.
2. Completely independent with hardware clock/calendar and software to maintain control independently.
3. Acquire, process, and transfer information to operator station or other control units on network.
4. Accept, process, and execute commands from other control unit's or devices or operator stations.
5. Access both data base and control functions simultaneously.
6. Record, evaluate, and report changes of state or value occurring among associated points. Continue to perform associated control functions regardless of status of network.
7. Perform in stand-alone mode:
   a. Start/stop.

b. Duty cycling.

c. Automatic Temperature Control.

d. Demand control via a sliding window, predictive algorithm.

e. Event initiated control.

f. Calculated point.

g. Scanning and alarm processing.

h. Full direct digital control.

i. Trend logging.

j. Global communications.

k. Maintenance scheduling.

D. Global Communications:

1. Broadcast point data onto network, making information available to other system controls units.

2. Transmit input/output points onto network for use by other control units and use data from other control units.

E. Input/output Capability:

1. Discrete/digital input (contact status).

2. Discrete/digital output.

3. Analog input.

4. Analog output.

5. Pulse input (5 pulses/second).

6. Pulse output (0-655 seconds in duration with 0.01-second resolution).

F. Monitor, control, or address data points. Include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs. Furnish control units with minimum 10 percent spare capacity.

G. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.

H. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard-wired LAN or 60 seconds over voice grade phone lines.

I. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:

1. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from workstation.

2. Control output points but change only database state or value; leave external field hardware unchanged.

3. Enable control-actions on output points but change only data base state or value.

J. Local display and adjustment panel: Integral to control-unit containing digital display, and numerical keyboard. Display and adjust:

1. Input/output point information and status.

2. Controller set points.

3. Controller tuning constants.

4. Program execution times.

5. High and low limit values.

6. Limit differential.

7. Set/display date and time.

8. Control outputs connected to the network.

9. Automatic control outputs.

10. Perform control unit diagnostic testing.

K. Points in "Test" mode.

L. DDC Controller:

1. DDC Controllers shall be a 16-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of

modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point I/O schedule. Each controller shall support a minimum of three (3) Floor Level Application Specific Controller Device Networks.

2. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:

   a. Control processes

   b. Energy management applications

   c. Alarm management applications including custom alarm messages for each level alarm for each point in the system.

   d. Historical/trend data for points specified

   e. Maintenance support applications

   f. Custom processes

   g. Operator I/O

   h. IPcommunications

   i. Manual override monitoring

3. Each DDC Controller shall support firmware upgrades without the need to replace hardware.

4. Provide all processors, power supplies and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.

5. The operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.

   a. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.

b. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.

6. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.

7. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

8. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:

   a. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V

   b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact

   c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power

   d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max)

   e. Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:

      1) IEEE Standard 587-1980

      2) UL 864 Supply Line Transients

   f. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)

9. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 60 days.

    a. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

    b. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via USB, Locally via communication port or from a network workstation PC.

10. Provide a separate DDC Controller for each AHU and/or other HVAC systems indicated in Section 3. It is intended that each unique system be provided with its own point resident DDC Controller.

M. HVAC Mechanical Equipment Controllers:

1. HVAC Mechanical Equipment Controllers shall be a 12-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors.

2. Each HVAC Mechanical Controller shall have sufficient memory to support its own operating system and databases, including:

    a. Control processes

    b. Energy management applications

    c. Alarm management applications including custom alarm messages for each level alarm for each point in the system.

    d. Historical/trend data for points specified

    e. Maintenance support applications

    f. Custom processes

    g. Operator I/O

    h. Dial-up communications

3. Each HVAC Mechanical Equipment Controller shall support firmware upgrades without the need to replace hardware.

4. HVAC Mechanical Equipment Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

5. Each HVAC Mechanical Equipment Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all components. The HVAC Mechanical Equipment Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

6. Isolation shall be provided at all peer-to-peer network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:

    a. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3 V

    b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact

    c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power

    d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max)

    e. Isolation shall be provided at all peer-to-peer panel's AC input terminals to suppress induced voltage transients consistent with:

        1) IEEE Standard 587-1980

        2) UL 864 Supply Line Transients

    f. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)

7. In the event of the loss of normal power, there shall be an orderly shutdown of all HVAC Mechanical Equipment Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration

data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

a. Upon restoration of normal power, the HVAC Mechanical Equipment Controller shall automatically resume full operation without manual intervention.

8. Should HVAC Mechanical Equipment Controller memory be lost for any reason, the user shall have the capability of reloading the HVAC Mechanical Equipment Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

N. Floor Level Network Application Specific Controllers (ASC)

1. Each DDC Controller shall be able to extend its performance and capacity through the use of remote application specific controllers (ASCs) through Floor Level LAN Device Networks.

2. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Provide the following types of ASCs as a minimum:

a. Central System Controllers

b. Terminal Equipment Controllers:

1) Each ASC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.

3. Central System Controllers:

a. Provide for control of central HVAC systems and equipment including, but not limited to, the following:

1) Air handling units

2) Rooftop units and split system

3) Chilled water system

4) Cooling towers and condenser water systems

5) Boilers and hot water systems

b. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Provide a hand/off/automatic switch for each digital output for manual override capability. Switches shall be mounted either within the controller's key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides. In addition, each switch position shall be supervised in order to inform the system that automatic control has been overridden.

c. Each controller shall support its own real-time operating system. Provide a time clock with battery backup to allow for stand-alone operation in the event communication with its DDC Controller is lost and to insure protection during power outages.

d. All programs shall be field-customized to meet the user's exact control strategy requirements. Central System controllers utilizing pre-packaged or canned programs shall not be acceptable. As an alternative, provide DDC Controllers for all central equipment in order to meet custom control strategy requirements.

e. Programming of central system controllers shall utilize the same language and code as used by DDC Controllers to maximize system flexibility and ease of use. Should the system controller utilize a different control language, provide a DDC Controller to meet the specified functionality.

f. Each controller shall have connection provisions for a portable operator's terminal. This tool shall allow the user to display, generate or modify all point databases and operating programs.

g. Provide a door-mounted interface terminal to allow for direct-user access to the controller.

1) The terminal shall provide the user with the following functionality as a minimum:

a) View and set date and time

b) Modify and override time-of-day schedules

c) View points and alarms

d) Monitor points

e) Command and modify setpoints

2) Provide local user display in accordance with paragraph 2.11

4. Terminal Equipment Controllers:

a. Provide for control of each piece of equipment, including, but not limited to, the following:

1) Variable Air Volume (VAV) boxes

2) Fan-Powered Variable Air Volume (FPVAV)

3) Terminal Devices

b. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be industry standard signals such as 24V floating control, 3-15 psi pneumatic, 0-10v, allowing for interface to a variety of modulating actuators.

c. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the FLN, BLN or MLN is not acceptable.

O. Additional features

1. The enclosure for all controllers shall be NEMA Type 4 which shall not be mounted directly to the unit nor to the wall. The conduit entering points must be located at bottom of the enclosure.

2. All controllers shall have manual overrides at the panels to manually adjust the setpoints without using computer or hand-held device.

2.5 LOCAL AREA NETWORKS (LAN):

A. The design of the BAS shall network operator workstations and stand-alone DDC Controllers (SAC). The network architecture shall consist of three levels, a campus-wide (Management Level Network) Ethernet network based on TCP/IP protocol, high performance peer-to-peer building level network(s) and DDC Controller floor level local area networks with access being totally transparent to the user when accessing

data or developing control programs. All controllers shall be standalone DDC (SAC) controllers. Loss of network communications shall not stop/limit the control sequences specified herein.

B. Provide communication between control units over local area network (LAN).

C. LAN Capacity: Not less than 100 stations or nodes.

D. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

E. LAN Data Speed: Minimum 56 Kb.

F. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

G. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

H. Network Support: Time for global point to be received by any station, less than 3 seconds. Furnish automatic reconfiguration when station is added or lost. In event transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

I. System shall have the capability to communicate with a BACnet network over Ethernet or BACnet/IP (according to Annex J). The intent is to use the system provided under this contract to communicate with control systems provided by other vendors. In order to accomplish monitoring, commanding, and alarming as described in sections 2.10.B and 2.10.D, the following BACnet objects and services must be supported by the system.

1. The following BACnet standard objects, at a minimum, must be supported by the system:
   a. Device
   b. Analog Input
   c. Analog Output
   d. Binary Input
   e. Binary Output
   f. Notification Class

2. The following BACnet services must be supported for the system to act as a BACnet server as described below:

   a. For the system to communicate with/on a BACnet network, it must support the following:

BACnet Service	Initiate	Execute
Who-Has		X
I-Have	X	
Who-Is		X
I-Am	X	

   b. For the system to allow other BACnet devices to monitor its point values, the system must support the following:

BACnet Service	Initiate	Execute
Read Property		X

   c. For the system to allow other BACnet devices to command its point values, the system must support the following:

BACnet Service	Initiate	Execute
Write Property		X

   d. For the system to be able to send alarms to other BACnet devices and receive alarm acknowledgement, the system must support the following:

BACnet Service	Initiate	Execute
Add List Element		X
Remove List Element		X
Acknowledge Alarm		X
Get Alarm Summary		X
Confirmed or Unconfirmed Event Notification	X	

   e. If the system will be sending messages to other BACnet devices via COV, it must support the following:

BACnet Service	Initiate	Execute
Subscribe COV		X
Confirmed or Unconfirmed COV Notification	X	

3. The following BACnet services must be supported for the system to act as a BACnet client as described below:

   a. For the system to communicate with/on a BACnet network, it must support the following:

BACnet Service	Initiate	Execute
Who-Has		X
I-Have	X	
Who-Is		X
I-Am	X	

   b. For the system to be able to monitor point values from other BACnet devices, the system must support the following:

BACnet Service	Initiate	Execute
Read Property	X	

   c. For the system to be able to command point values in other BACnet devices, the system must support the following:

BACnet Service	Initiate	Execute
Write Property	X	

   d. For the system to be able to receive alarms from points in other BACnet devices, the system must support the following:

BACnet Service	Initiate	Execute
Add List Element	X	
Remove List Element	X	
Acknowledge Alarm	X	
Get Alarm Summary	X	
Confirmed or Unconfirmed Event Notification		X

   e. If the system is capable of receiving BACnet point messages via COV, it must support the following:

BACnet Service	Initiate	Execute
Subscribe COV	X	
Confirmed or Unconfirmed COV Notification		X

J. Peer-to-Peer Building Level Network:

1. All operator devices either network resident shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the peer-to-peer network. No hardware or software limits shall be imposed on the number of devices with global access to the network data at any time.

2. The peer-to-peer network shall support a minimum of 100 DDC controllers and PC workstations

3. Each PC workstation shall support a minimum of 4 peer to peer networks hardwired.

4. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, air conditioning units, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for interprocess control. All exchange points shall have full system functionality as specified herein for hardwired points.

5. Field panels must be capable of integration with open standards including Modbus, BACnet, and Lonworks as well as with third party devices via existing vendor protocols.

6. Telecommunication Capability and Remote Access:

   a. Communications shall be provided to allow DDC Controllers to communicate with remote operator stations and/or remote terminals via a remotely accessible website. Website address for monitoring and control will be determined by the Commissioner and shall be in the form of a standard "www." web address.

   b. Access to the BMS shall be done securely with a username and password. Users shall be able to log in on individual accounts, for security the BMS shall record all changes done remotely for each account and shall log out automatically after 10 minutes of inactivity.

   c. Remotely accessible BMS shall feature a graphical user interface which shall be compatible with standard web browsers.

d. DDC Controllers shall automatically report alarms or other significant events. This shall be done via email, text message or telephone call as determined by the Commissioner.

e. Operators at remote workstations shall be able to perform all control functions, all report functions and all database generation and modification functions as described for workstations connected via the network. At a minimum the following shall be available remotely: Monitoring, Control and adjust of points/point-values, Transaction recording, Alarming, Historical trend data viewing, Totalization data and Scheduling.

K. Management Level Network:

1. All PCs shall simultaneously direct connect to the Ethernet and Building Level Network without the use of an interposing device

2. Operator Workstation shall be capable of simultaneous direct connection and communication with BACnet, OPC, and Apogee networks without the use of interposing devices.

3. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.

4. When appropriate, any controller residing on the peer to peer building level networks shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.

5. Any PC on the Ethernet Management Level Network shall have transparent communication with controllers on the building level networks connected via Ethernet, as well as, directly connected building level networks. Any PC shall be able to interrogate any controller on the building level network.

6. Any break in Ethernet communication from the PC to the controllers on the building level networks shall result in an alarm notification at the PC and shall not stop/limit operation of the system.

7. The Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3

8. Access to the system database shall be available from any client workstation on the Management Level Network.

2.6 OPERATING SYSTEM SOFTWARE

A. Input/output Capability From Operator Station:

1. Request display of current values or status in tabular or graphic format.
2. Command selected equipment to specified state.
3. Initiate logs and reports.
4. Change analog limits.
5. Add, delete, or change points within each control unit or application routine.
6. Change point input/output descriptors, status, alarm descriptors, and unit descriptors.
7. Add new control units to system.
8. Modify and set up maintenance scheduling parameters.
9. Develop, modify, delete or display full range of color graphic displays.
10. Automatically archive select data even when running third party software.
11. Capability to sort and extract data from archived files and to generate custom reports.
12. Support two printer operations.
13. Alarm printer: Print alarms, operator acknowledgments, action messages, system alarms, operator sign-on and sign-off.
14. Data printer: Print reports, page prints, and data base prints.
15. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
16. Print selected control unit database.

B. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.

C. Data Base Creation and Support: Use standard procedures for changes. Control unit automatically checks workstation data base files upon connection and verify data base match. Include the following minimum capabilities:

1. Add and delete points.
2. Modify point parameters.
3. Change, add, or delete English language descriptors.
4. Add, modify, or delete alarm limits.
5. Add, modify, or delete points in start/stop programs, trend logs, and other items.
6. Create custom relationship between points.
7. Create or modify DDC loops and parameters.
8. Create or modify override parameters.
9. Add, modify, and delete applications programs.
10. Add, delete, develop, or modify dynamic color graphic displays.

D. Dynamic Color Graphic Displays:

1. Utilizes custom symbols or system supported library of symbols.
2. Sixteen (16) colors.
3. Sixty (60) outputs of real-time live dynamic data for each graphic.
4. Dynamic graphic data.
5. 1,000 separate graphic pages.
6. Modify graphic screen refresh rate between 1 and 60 seconds.

E. Operator Station:

1. Accept data from LAN as needed without scanning entire network for updated point data.
2. Interrogate LAN for updated point data when requested.
3. Allow operator command of devices.

4. Allow operator to place specific control units in or out of service.

5. Allow parameter editing of control units.

6. Store duplicate data base for every control unit and allow down loading while system is on line.

7. Control or modify specific programs.

8. Develop, store and modify dynamic color graphics.

9. Data archiving of assigned points and support overlay graphing of this data using up to four (4) variables.

F. Alarm Processing:

1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state or value and alarms causing automatic dial-out.

2. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.

3. Print on line changeable message, up to 60 characters in length, for each alarm point specified.

4. Display alarm reports on video. Display multiple alarms in order of occurrence.

5. Define time delay for equipment start-up or shutdown.

6. Allow unique routing of specific alarms.

7. Operator specifies when alarm requires acknowledgment.

8. Continue to indicate unacknowledged alarms after return to normal.

9. Alarm notification:

10. Print automatically.

11. Display indicating alarm condition.

12. Selectable audible alarm indication.

G. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may

be value crossing operator defined limit, change of state, specified state, or alarm occurrence or return to normal.

H. Automatic Restart: Automatically start field equipment on restoration of power. Furnish time delay between individual equipment restart and time of day start/stop.

I. Messages:

1. Automatically display or print user-defined message subsequent to occurrence of selected events.

2. Compose, change, or delete message.

3. Display or log message at any time.

4. Assign any message to event.

J. Reports:

1. Manually requested with time and date.

2. Lifetime of the BMS data archiving to hard disk.

3. Automatic directives to download to transportable media including removable media for storage.

4. Data selection methods to include data base search and manipulation.

5. Data extraction with mathematical manipulation.

6. Data reports to allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.

7. Generating reports either normally at operator direction, or automatically under workstation direction.

8. Either manually display or print reports. Automatically print reports on daily, weekly, monthly, yearly or scheduled basis.

9. Include capability for statistical data manipulation and extraction.

10. Capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.

K. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.

L. Data Collection:

1. Automatically collect and store in disk files.
2. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 5-year period.
3. Daily consumption for up to 30 meters over a 5 year period.
4. Daily billable electrical energy consumption and time for up to 1024 zones over a 25 year period.
5. Archiving of stored data for use with system supplied custom reports.

M. Graphic Display: Support graphic development on work station with software features:

1. Page linking.
2. Generate, store, and retrieve library symbols.
3. Single or double height characters.
4. Sixty (60) dynamic points of data for each graphic page.
5. Pixel level resolution.
6. Animated graphics for discrete points.
7. Analog bar graphs.
8. Display real time value of each input or output line diagram fashion.

N. Maintenance Management:

1. Run time monitoring, for each point.
2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
3. Equipment safety targets.
4. Display of maintenance material and estimated labor.

5. Target point reset, for each point.

O. Advisories:

1. Summary containing status of points in locked out condition.

2. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.

3. Report of power failure detection, time and date.

4. Report of communication failure with operator device, field interface unit, point and programmable control unit.

2.7 LOAD CONTROL PROGRAMS

A. General: Support inch-pounds and S.I. metric units of measurement.

B. Demand Limiting:

1. Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.

2. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.

3. Forecast demand (kW): Predicted by sliding window method.

4. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.

5. Demand Target: Minimum of 3 for each demand meter; change targets based upon (1) time, (2) status of pre-selected points, or (3) temperature.

6. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.

7. Limits: Include control band (upper and lower limits).

8. Output advisory when loads are not available to satisfy required shed quantity, advise shed requirements [and requiring operator acknowledgment].

C. Duty Cycling:

1. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.

2. Modify off portion of cycle based on operator specified comfort parameters. Maintain total cycle time by increasing on portion of cycle by equal quantity off portion is reduced.

3. Set and modify following parameters for each individual load.

   a. Minimum and maximum off time.

   b. On/Off time in one-minute increments.

   c. Time period from beginning of interval until cycling of load.

   d. Manually override the DDC program and place a load in an On or Off state.

   e. Cooling Target Temperature and Differential.

   f. Heating Target Temperature and Differential.

   g. Cycle off adjustment.

D. Automatic Time Scheduling:

1. Self-contained programs for automatic start/stop/scheduling of building loads.

2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.

3. Special day's schedule supporting up to 30 unique date/duration combinations.

4. Number of loads assigned to time program; with each load having individual time program.

5. Each load assigned at least 16 control actions for each day with 1 minute resolution.

6. Furnish the following time schedule operations:

   a. Start.

b. Optimized Start.

c. Stop.

d. Optimized Stop.

e. Cycle.

f. Optimized Cycle.

7. Capable of specifying minimum of 30 holiday periods up to 100 days in length for the year.

8. Create temporary schedules.

9. Broadcast temporary "special day" date and duration.

E. Start/Stop Time Optimization:

1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.

2. Adaptive and self-tuning, adjusting to changing conditions unattended.

3. For each point under control, establish and modify:

a. Occupancy period.

b. Desired temperature at beginning of occupancy period.

c. Desired temperature at end of occupancy period.

F. Night Setback/Setup Program: Reduce heating space temperature set point or raise cooling space temperature set-point during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.

G. Calculated Points: Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.

1. Employ arithmetic, algebraic, Boolean, and special function operations.

2. Treat calculated values like any other analog value; use for any function where a "hard wired point" might be used.

H. Event Initiated Programming: Any data point capable of initiating event, causing series of controls in a sequence.

1. Define time interval between each control action between 0 to 3600 seconds.

2. Output may be analog value.

3. Provide for "skip" logic.

4. Verify completion of one action before proceeding to next action. When not verified, program capable of skipping to next action.

I. Direct Digital Control: Furnish with each control unit Direct Digital Control software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.

1. Control loops: Defined using "modules" are analogous to standard control devices.

2. Output: Paired or individual digital outputs for pulse width modulation, and analog outputs.

3. Firmware:

a. PID with analog or pulse-width modulation output.

b. Floating control with pulse-width modulated outputs.

c. Two-position control.

d. Primary and secondary reset schedule selector.

e. Hi/Low signal selector.

f. Single pole double-throw relay.

g. Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.

4. Direct Digital Control loop: Downloaded upon creation or on operator request. On sensor failure, program executes user defined failsafe output.

5. Display: Value or state of each of lines interconnecting DDC modules.

J. Fine Tuning Direct Digital Control PID or floating loops:

1. Display information:

a. Control loop being tuned.

b. Input (process) variable.

c. Output (control) variable.

d. Set-point of loop.

e. Proportional band.

f. Integral (reset) Interval.

g. Derivative (rate) Interval.

2. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" versus "variable".

K. Trend logging:

1. Each control unit capable of storing samples of control unit's data points.

2. Update file continuously at operator assigned intervals.

3. Automatically initiate upload requests and then stores data on hard disk.

4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.

5. Co-ordinate sampling with specified on/off point- state.

6. Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

2.8 HVAC CONTROL PROGRAMS

A. General:

1. Support Inch-pounds and S.I. metric units of measurement.

2. Identify each Control system.

B. Optimal Run Time:

1. Control start-up and shutdown times of equipment for both heating and cooling.
2. Base on occupancy schedules, outside air temperature, seasonal requirements, interior room mass temperature and zone CO2.
3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
4. Use outside air temperature to determine early shut down with ventilation override.
5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
6. Operator commands:
    a. Define term schedule.
    b. Add/delete fan status point.
    c. Add/delete outside air temperature point.
    d. Add/delete mass temperature point.
    e. Define heating/cooling parameters.
    f. Define mass sensor heating/cooling parameters.
    g. Lock/unlock program.
    h. Request optimal run-time control summary.
    i. Request optimal run-time mass temperature summary.
    j. Request point summary.
    k. Request saving profile summary.
7. Control Summary:
    a. Control system begin/end status.
    b. Optimal run time lock/unlock control status.
    c. Heating/cooling mode status.

d. Optimal run time schedule.

e. Start/Stop times.

f. Selected mass temperature point ID.

g. Optimal run-time system normal start-times.

h. Occupancy and vacancy times.

i. Optimal run time system heating/cooling mode parameters.

8. Mass temperature summary:

a. Mass temperature point type and ID.

b. Desired and current mass temperature values.

c. Calculated warm-up/cool-down time for each mass temperature.

d. Heating/cooling season limits.

e. Break point temperature for cooling mode analysis.

9. Point summary:

a. Control system identifier and status.

b. Point ID and status.

c. Outside air temperature point ID and status.

d. Mass temperature point ID and status.

e. Calculated optimal start and stop times.

f. Period start.

C. Supply Air Reset:

1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.

2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:

a. Raising cooling temperatures to highest possible value.

b. Reducing heating temperatures to lowest possible level.

3. Operator commands:

a. Add/delete fan status point.

b. Lock/unlock program.

c. Request point summary.

d. Add/Delete discharge controller point.

e. Define discharge controller parameters.

f. Add/delete air flow rate.

g. Define space load and load parameters.

h. Request space load summary.

4. Control summary:

a. Control system status (begin/end).

b. Supply air reset system status.

c. Optimal run time system status.

d. Heating and cooling loop.

e. High/low limits.

f. Deadband.

g. Response timer.

h. Reset times.

5. Space load summary:

a. System status.

b. Optimal run time status.

c. Heating/cooling loop status.

d. Space load point ID.

e. Current space load point value.

f. Control heat/cool limited.

g. Gain factor.

h. Calculated reset values.

i. Fan status point ID and status.

j. Control discharge temperature point ID and status.

k. Space load point ID and status.

l. Airflow rate point ID and status.

D. Static Pressure Reset:

1. Monitor static pressure in supply air system and corresponding VAV box position.

2. Reduce static pressure setpoint and resultant fan speed to utilize minimum fan energy.

E. Enthalpy Switchover:

1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.

2. Operator commands:

a. Add/delete fan status point.

b. Add/delete outside air temperature point.

c. Add/delete discharge controller point.

d. Define discharge controller parameters.

e. Add/delete return air temperature point.

f. Add/delete outside air dewpoint/humidity point.

g. Add/delete return air dewpoint/humidity point.

h. Add/delete damper switch.

i. Add/delete minimum outside air.

j. Add/delete atmospheric pressure.

k. Add/delete heating override switch.

l. Add/delete evaporative cooling switch.

m. Add/delete air flow rate.

n. Define enthalpy deadband.

o. Lock/unlock program.

p. Request control summary.

q. Request HVAC point summary.

3. Control summary:

a. HVAC control system begin/end status.

b. Enthalpy switchover optimal system status.

c. Optimal return time system status.

d. Current outside air enthalpy.

e. Calculated mixed air enthalpy.

f. Calculated cooling cool enthalpy using outside air.

g. Calculated cooling cool enthalpy using mixed air.

h. Calculated enthalpy difference.

i. Enthalpy switchover deadband.

j. Status of damper mode switch.

k. Zone CO2

F. Freeze protection.

G. Fan High static and low suction protection.

H. Smoke Control.

2.9 CHILLER PLANT CONTROL PROGRAMS

A. Control function of condenser water reset, chilled water reset, and chiller sequencing. Support inch-pounds and S.I. metric units of measurement.

B. Condenser Water Reset: Automatically reset controlled condenser water temperature using measured outside wet bulb temperature and load being handled.

C. Chilled Water Reset: Automatically reset controlled chilled water temperature satisfying cooling coil requiring greatest cooling.

D. Chiller Sequencing: Determine combination of chillers most efficiently satisfies chilled water load, by cycling chillers, based on comparing load to switchover limits defined for each chiller.

E. Chiller Plant Optimization Program: This program shall be based on a knowledge of requirements in this Section, as well as consultation with manufacturers of chillers and all auxiliaries such as pumps, cooling towers, etc., as to performance and operation of each component, not only at design conditions but at all other load conditions as well.

System analysis and programming shall be done in stages as described below and contractor shall provide all required hardware required for its implementation:

1. Control leaving chilled water temperature of each chiller.

2. Turn on and off as needed auxiliary motors, valves, pumps, and so on, all under full software stored program control.

3. Chiller water temperature reset.

4. Control or proportion the total refrigeration (tons) load each chiller will produce at various partial loads, based on optimized efficiency of operation of total plant.

5. Control condenser water temperature and relate to actual needs of Chiller Plant.

6. Adjust speed of variable frequency drives to maintain proper condenser water and chilled water flow rates to each chiller.

2.10 PROGRAMMING APPLICATION FEATURES

A. Trend Point:

1. Sample up to 50 points, real or computed, with each point capable of collecting 10,000 samples at intervals specified in minutes, hours, days, or month.

2. Output trend logs as line-graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique color, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.

B. Alarm Messages:

1. Allow definition of minimum of 100 messages, each having minimum length of 100 characters for each individual message.

2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totaled point's warning limit, hardware elements advisories.

3. Output assigned alarm with "message requiring acknowledgment".

4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

C. Weekly Scheduling:

1. Automatically initiate equipment or system commands, based on selected time schedule for points specified.

2. Program times for each day of week, for each point, with one minute resolution.

3. Automatically generate alarm output for points not responding to command.

4. Allow for holidays, minimum of 366 consecutive holidays.

5. Operator commands:

a. System logs and summaries.

b. Start of stop point.

c. Lock or unlock control or alarm input.

d. Add, delete, or modify analog limits and differentials.

e. Adjust point operation position.

f. Change point operational mode.

g. Open or close point.

h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.

i. Begin or end point totals.

j. Modify total values and limits.

k. Access or secure point.

l. Begin or end HVAC or load control system.

m. Modify load parameter.

n. Modify demand limiting and duty cycle targets.

6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

D. Interlocking:

1. Permit events to occur, based on changing condition of one or more associated master points.

2. Binary contact, high/low limit of analog point or computed point capable of being used as master. Master capable of monitoring or commanding multiple slaves.

3. Operator commands:

a. Define single master/multiple master interlock process.

b. Define logic interlock process.

c. Lock/unlock program.

d. Enable/disable interlock process.

e. Execute terminate interlock process.

f. Request interlock type summary.

E. Interface to World Wide Web:

1. Contractor shall provide all programming and interfaces as required to display and access all system features, including alarms, maintenance messages, graphics, etc. on the World Wide Web.

2. The central BAS console shall be arranged to monitor, control and supervise all system items specified in this section, remotely, via the World Wide Web, using secured network connections. Specific alarms as defined by the Commissioner shall be connected to the Campus Public Safety Network. Contractor shall be responsible for all software and hardware requirements, as required for a complete and operational system. Contractor shall be responsible for coordinating network interface requirements with the Commissioner.

3. Coordinate Uniform Resource Locator (URL) address name with Commissioner and provide all fees associated with obtaining rights to URL. Contractor shall be responsible for coordinating and obtaining Internet Service Provider.

2.11 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Disconnect Switch: Factory-mount on equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditioned power supply is available to control units and to operator workstation.

B. Verify field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Install software in control units and in operator workstation. Implement features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 09 93.

C. Install with 120 volts alternating current, 15 amp dedicated emergency power circuit to each programmable control unit.

D. Install conduit and electrical wiring in accordance with Section 26 05 03.

E. Install electrical material and installation in accordance with appropriate requirements of Division 26.

F. Install all devices, sensors, etc. in sheet metal enclosures to prevent dust, dirt and water damage. Provide outdoor rated enclosures for devices exposed to weather.

3.3 MANUFACTURER'S FIELD SERVICES

A. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation.

B. Furnish [service technician employed by system installer] to instruct Commissioner in operation of systems plant and equipment for [3] day period.

3.4 COMMISSIONING, TESTING AND ACCEPTANCE

A. Perform a three-phase commissioning procedure consisting of field I/O calibration and commissioning, system commissioning and integrated system program commissioning. Document all commissioning information on commissioning data sheets which shall be submitted prior to acceptance testing. Commissioning work which requires shutdown of system or deviation from normal function shall be performed when the operation of the system is not required. The commissioning must be coordinated with the Commissioner to ensure systems are available when needed. Notify the Commissioner in writing of the testing schedule so that authorized personnel from the Commissioner are present throughout the commissioning procedure.

1. Prior to system program commissioning, verify that each control panel has been installed according to plans, specifications and approved shop drawings. Test, calibrate and bring on line each control sensor and device. Commissioning to include, but not be limited to:

a. Sensor accuracy at 10, 50 and 90% of range.

b. Sensor range.

c. Verify analog limit and binary alarm reporting.

d. Point value reporting.

e. Binary alarm and switch settings.

f. Actuator ranges.

g. Fail safe operation on loss of control signal, electric power, network communications.

B. After control devices have been commissioned (i.e. calibrated, tested and signed off), each BAS program shall be put on line and commissioned. The contractor shall, in the presence of the Commissioner, demonstrate each programmed sequence of operation and compare the results in writing. In addition, each control loop shall be tested to verify proper response and stable control, within specified accuracy's. System program test results shall be recorded on commissioning data sheets and submitted for record. Any discrepancies between the specification and the actual performance will be immediately rectified and retested.

C. After all BAS programs have been commissioned, the contractor shall verify the overall system performance as specified. Tests shall include, but not be limited to:

1. Data communication, both normal and failure modes.
2. Fully loaded system response time.
3. Impact of component failures on system performance and system operation.
4. Time/Date changes.
5. End of month/ end of year operation.
6. Season changeover.
7. Global application programs and point sharing.
8. System backup and reloading.
9. System status displays.
10. Diagnostic functions.
11. Power failure routines.
12. Battery backup.
13. Smoke Control, stair pressurization, stair, vents, in concert with Fire Alarm System testing.
14. Testing of all electrical and HVAC systems with other division of work.

D. Submit for approval, a detailed acceptance test procedure designed to demonstrate compliance with contractual requirements. This Acceptance test procedure will take place after the commissioning procedure but before final acceptance, to verify that sensors and control devices maintain specified accuracy's and the system performance does not degrade over time.

E. Using the commissioning test data sheets, the contractor shall demonstrate each point. The contractor shall also demonstrate all system functions. The contractor shall demonstrate all points and system functions until all devices and functions meet specification.

F. The contractor shall supply all instruments for testing and turn over same to the Commissioner after acceptance testing.

1. All test instruments shall be submitted for approval.

a. Test Instrument Accuracy:

Temperature:	1/4F or 1/2% full scale, whichever is less.
Pressure:	High Pressure (psi): 1/2 psi or 1/2% full scale, whichever is less.
Low Pressure: (in w.c.)	1/2% of full scale
Humidity:	2% RH
Electrical:	1/4% full scale

G. After the above tests are complete and the system is demonstrated to be functioning as specified, a thirty day performance test period shall begin. If the system performs as specified throughout the test period, requiring only routine maintenance, the system shall be accepted. If the system fails during the test, and cannot be fully corrected within eight hours, the Commissioner may request that performance tests be repeated.

3.5 DEMONSTRATION AND TRAINING

A. General Conditions - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Furnish basic operator training for 16 persons on data display, alarm and status descriptors, requesting data, execution commands and log

requests. Include a minimum of 40 hours instructor time. Furnish training on site.

C. Demonstrate complete and operating system to Commissioner.

3.6 ELECTRICAL WIRING AND MATERIALS

A. Install, connect and wire the items included under this Section and all other Sections of HVAC work. This work includes providing required conduit, wire, fittings, transformers and related wiring accessories. All conduit and wiring shall be installed in accordance with Division 26 Specifications.

B. Provide conduit and wiring between thermostats, aquastats and unit heater motors, all control and alarm wiring for all control and alarm devices for all Sections of Specifications.

C. Provide 120 volt, single phase, 60 hertz emergency power to every B.M.S. DDC Controller panel, HVAC/Mechanical Equipment Controller, PC console, power supply, transformer, annunciator, modems, printers and to other devices as required. It is the intent that the entire building management system except terminal equipment shall be operative under emergency power conditions in the building.

D. Provide status function conduit and wiring for equipment covered under this Section.

E. Provide conduit and wiring between the B.M.S. panels and the temperature, humidity, or pressure sensing elements, including low voltage control wiring in conduit.

F. Provide conduit and control wiring for devices specified in this Section.

G. Provide conduit and signal wiring between motor starters/disconnect switches in motor control centers and high and/or low temperature relay contacts and remote relays in B.M.S. panels located in the vicinity of motor control centers.

H. Provide conduit and wiring between the PC workstation, electrical panels, metering instrumentation, indicating devices, miscellaneous alarm points, remotely operated contractors, and B.M.S. panels, as shown on the drawings or as specified.

I. All wiring to be compliant to local building code and the NEC.

J. Provide all conduit wiring for boiler systems, chillers, AC units, etc. as required for a complete and operational system.

K. Provide electrical wall box and conduits for all wall mounted devices.

L. Reference Division 26 Specifications and drawings for conduit, wiring and accessories requirements.

END OF SECTION

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SECTION 23 09 93

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes points to be connected to DDC control system.

B. Related Sections:

1. Section 23 09 00 - Instrumentation and Control for HVAC: For equipment, devices, and system components to implement sequences of operation.

2. Section 23 09 23 - Direct-Digital Control System for HVAC: For equipment, devices, system components, and software to implement sequences of operation.

3. All sections related to products requiring control and monitoring.

1.2 SUBMITTALS

A. General Conditions: Submittal procedures.

B. Shop Drawings: Indicate mechanical system controlled and control system components.

1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.

2. Submit flow diagrams for each control system, graphically depicting control logic.

3. Submit draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

4. Coordinate submittals with information requested in Section 23 09 00 and 23 09 23.

1.3 CLOSEOUT SUBMITTALS

A. General Conditions: Closeout procedures.

B. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 POINTS TO BE CONNECTED TO DDC SYSTEM

A. Chiller Plant:

1. Refer to control diagrams and sequences of operations

B. Boiler (Steam) and Heating Hot Water System:

1. Refer to control diagrams and sequences of operations

C. Air Handling Units:

1. Refer to control diagrams and sequences of operations

D. Air Conditioning Units and Supplemental Cooling Units:

1. Start/ Stop and running Status
2. Room temperature setpoint and actual temperature
3. Common alarm

E. All Pumps and fans:

1. Start/Stop and running Status
2. Interlock with respective system
3. Alarm failure on start/stop

F. VAV Boxes:

1. Space Temperature
2. Flow Rate
3. Damper position and valve position (if applicable)

G. High Temperature Alarms in the following rooms:

1. Telecom Rooms

H. Miscellaneous HVAC Points:

1. Outdoor air temperature and relative humidity

2. Variable Frequency Drives - General Fault

I. Miscellaneous Electrical Points:

1. Fire Alarm Status (as read from AHU control panel)

2. Lighting control points

3.2 TYPICAL MULTI-ZONE CONSTANT VOLUME AC UNIT WITH CHILLED WATER COIL (AC-5, AC-6, AC-7):

A. System Description and Start-up

1. Constant volume multi-zone air handling unit with a supply and return fan. Supply air conditions are maintained by mixing hot deck air and cold deck air, where the off-season deck serves as bypass. Preliminary heating shall be via a low pressure steam pre-heat coil ahead of the hot/cold deck arrangement. Hot deck heating shall be via low pressure steam. Cold deck cooling shall be via a chilled water cooling coil. During Winter Mode operation, the cooling coil control valve remains closed. During the Summer Mode operation, the heating coil control valve remains closed.

2. Unit shall operate on a time of day schedule in conjunction with preset settings defined within summer and winter modes. Additionally, the BMS shall have to ability to over-ride (if applicable) and engage the system.

3. When available, unit shall be able to engage economizer mode to provide free cooling and enter into demand-control ventilation to maintain acceptable CO2 levels with reduced OA.

4. Preheat coil:

a. When the supply and return fans are operating, and the preheat coil discharge temperature is less than 45 deg F (adj.), the preheat control valve shall modulate open to maintain 45 deg F (adj.) preheat coil discharge temperature.

b. When the supply and return fans are not operating, and the outdoor temperature sensor in the OA intake plenum is less than 40 deg F (adj.), the preheat control valve shall

modulate open to maintain 45 deg F (adj.) plenum temperature.

5. Safeties.

   a. Fire alarm: When signaled by the fire alarm system the supply fan and return fan shall shutdown; Dampers and valves shall positions to their fail safe positions. A signal shall be generated at the BMS.

   b. Freeze-stat: Preheat coil shall have a freeze-stat to prevent the downstream coils from freezing. When the preheat coil discharge temperature drops below 36 deg F (adj.), the unit shall shut off. Manual reset shall be required.

   c. HL and LL Alarms: See point map for respective unit for high level and low level alarms.

   d. Monitoring: See point map for respective unit for points to be monitored on the BMS.

B. Operation:

1. Summer/Winter mode shall operate based on outdoor temperatures as follows. The BMS shall have the ability to over-ride the OA temperature-based method to engage either mode.

2. Summer mode: When the temperature outside is greater than 60 deg F (adj.), the unit shall be placed into summer mode. The heating coil control valve shall remain closed during summer mode operation.

   a. Cool-down mode (unoccupied)

      1) Based upon outdoor and indoor temperatures, the controller shall schedule an optimum time to engage cool-down mode prior to operating in cooling mode. Additionally, the system shall operate in cool-down mode upon a demand from the BMS.

      2) The minimum and maximum OA damper and the minimum and maximum EA damper shall remain closed during cool-down mode operation; the RA damper shall remain open. The SA and RA fans shall be energized. The cooling coil valve shall modulate to maintain a discharge temperature 55 deg F (adj.).

Once the space temperature has reached 78 deg F (adj.) the cooling coil valve shall begin to close slowly until the space temperature has reach 75 deg F (adj.). The unit shall then enter cooling mode.

3) When the outside air temperature is 10 deg F (adj., recommended minimum indicated) cooler than the space temperature and wet bulb is 63°F or less, the unit shall use the economizer dampers to purge the space and achieve complete or partial cool-down. Both OA dampers and both EA dampers shall open; the RA damper shall close.

b. Cooling Mode (occupied)

1) The minimum OA damper and EA damper shall open. The maximum OA damper and EA damper shall remain closed. The RA damper shall remain open. Dampers shall remain in this position unless economizer operation or DCV sequence overrides.

2) SA and RA fan shall be energized and remain operational during cooling mode operation.

3) Economizer operation shall be the first method of cooling if conditions are met as per Economizer Mode section, below.

4) The space temperature shall be maintained by modulating its respective zone damper that mixes conditioned cold deck air and unconditioned by-pass air. The zone damper shall modulate to maintain a discharge temperature of 60 deg F (adj.) supply air when the space temperature is 78 deg F (adj.) or below. The zone damper shall modulate to maintain a discharge temperature of 55 deg F (adj.) supply air when the space temperature is above 78 deg F (adj.).

5) When any zone space temperature rises above its cooling set-point of 75 deg F (adj.), the cold deck shall be activated by slowly opening the cooling coil valve. The zone with the highest space temperature shall control the cold deck discharge temperature set point, which shall be maintained via modulating the

cooling coil control valve. When the zone with the highest space temperature is 76 deg F (adj.) or below, the cooling coil control valve shall modulate to maintain 60 deg F (adj.) cold deck discharge temperature. When the zone with the highest space temperature is above 76 deg F (adj.), the cooling coil control valve shall modulate to maintain 55 deg F (adj.) cold deck discharge temperature.

6) The PID loop shall have a 5 deg F (adj.) dead band to prevent overshoot.

7) System shall operate in cooling mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

3. Winter Mode: When the outside air temperature is less than 55 deg F (adj.), the unit shall be placed into winter mode. The cooling coil control valve shall remain closed during winter mode operation. The unit shall operate in occupied or unoccupied heating mode as per time of day schedule or as per command from BMS.

a. Heating mode (unoccupied)

1) OA and EA dampers shall be closed. RA damper shall be open.

2) Space temperature shall be monitored at unoccupied times.

3) When any space temperature drops below 55 deg F (adj.), the SA and RA fans shall be energized. The heating coil control valve shall modulate to maintain a supply air temperature of 75 deg F.

4) When the space temperature has reached 63 deg F (adj.), the SA and RA fans shall be de-energized. The heating coil control valve shall modulate closed.

5) When engaged, this mode shall operate for a minimum of 5 minutes.

b. Warm-up mode

1) Based upon outdoor and indoor temperatures, the controller shall schedule an optimum time to engage

warm-up mode prior to operating in heating mode. Additionally, the system shall operate in warm-up mode upon a demand from the BMS.

2) The minimum and maximum OA damper and the minimum and maximum EA damper shall remain closed during warm-up mode operation; the RA damper shall remain open. The SA and RA fans shall be energized. The heating coil control valve shall modulate to maintain a hot deck temperature of 90 deg F (adj.).

3) The space temperature shall be maintained by modulating its respective zone damper that mixes conditioned hot deck air and unconditioned by-pass air. The zone damper shall modulate to maintain a discharge temperature of 90 deg F (adj.) supply air when the space temperature is below (or equal to) the set point temperature of 68 deg F (adj.). The zone damper shall modulate to maintain a discharge temperature of 85 deg F (adj.) supply air when the space temperature is between 68 deg F (adj.) and 72 deg F (adj.). Zone dampers shall modulate to maintain reduced zone discharge temperatures suitable for maintaining its respective zone temperature of 72 deg F (adj.). The unit shall enter heating mode when all zones reach space set-point temperature of 72 deg F (adj.).

c. Heating mode (occupied)

1) The minimum OA damper and EA damper shall open. The maximum OA damper and EA damper shall remain closed. The RA damper shall remain open. Dampers shall remain in this position unless economizer operation or DCV sequence overrides.

2) SA and RA fan shall be energized and remain operational during occupied heating mode operation.

3) The system shall operate in economizer cooling operation when any space temperature rises above 77 deg F (adj.). See Economizer Mode for sequence.

4) The space temperature shall be maintained by modulating its respective zone damper that mixes conditioned hot deck air and unconditioned by-pass air. The zone damper shall modulate to maintain a discharge temperature of 80 deg F (adj.) supply air when the space temperature is 65 deg F (adj.) or below. The zone damper shall modulate to maintain a discharge temperature of 70 deg F (adj.) supply air when the space temperature is above 65 deg F (adj.).

5) When any zone space temperature falls below its heating set-point of 70 deg F (adj.), the hot deck shall be activated by slowly opening the heating coil valve. The zone with the lowest space temperature shall control the hot deck discharge temperature set point, which shall be maintained via modulating the heating coil control valve. When the zone with the lowest space temperature is 65 deg F (adj.) or below, the heating coil control valve shall modulate to maintain 85 deg F (adj.) hot deck discharge temperature. When the zone with the lowest space temperature above 65 deg F (adj.), the heating coil control valve shall modulate to maintain 75 deg F (adj.) hot deck discharge temperature.

6) The PID loop shall have a 5 deg F (adj.) dead band to prevent overshoot.

7) System shall operate in heating mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

4. Economizer Mode:

a. Economizer Mode (Cooling Mode):

1) When the system is in Cooling Mode, the Economizer Mode shall be used as the first method of cooling. When the outside air temperature is between 55 deg F (adj.) and 65 deg F (adj.) and the OA enthalpy is less than the RA enthalpy, the system shall operate in Economizer Mode. The minimum OA damper and EA damper shall remain open.

2) The maximum OA and EA dampers shall modulate open in conjunction with the chilled water control valve when needed, to maintain the required cold deck temperature.

3) When the maximum OA and EA dampers are open 100%, the RA damper shall close.

b. Economizer Mode - Heating Mode, Occupied

1) When the system is in Heating Mode (occupied), the Economizer Mode shall function as "free cooling" when one of the spaces served by the system requires cooling. The minimum OA damper and EA damper shall remain open.

2) The system shall operate in economizer cooling operation when any space temperature rises above 77 deg F (adj.) and the outdoor temperature is equal to or below 60 deg F (adj.).

3) The maximum outdoor air damper shall modulate open to maintain a cold deck temperature of 60 deg F (adj.). When any space temperature reaches 82 deg F (adj.), the maximum outdoor air damper shall modulate to maintain a cold deck air temperature of 55 deg F (adj.). The maximum EA damper shall modulate with the maximum OA damper.

4) Economizer free cooling shall be disengaged when there is no longer any space temperature above 77 deg F (adj.), or when the mixed air temperature is below of 50 deg F (adj.).

5. Demand Control Ventilation (DCV):

a. Upon unit start-up, system shall operate in normal occupied mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

b. DCV shall over-ride minimum OA damper and EA damper controls in occupied mode.

c. DCV Damper Control

1) If all the space and duct sensor carbon dioxide levels are less than 500ppm above outdoor levels, and less than 900 ppm overall, for a minimum of 5 minutes, then the outdoor air flow rate shall be reduced to 50% of minimum outdoor flow rate indicated in Contract Schedules, via modulating the minimum OA damper and EA damper.

2) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoors levels or greater than 900 ppm overall, the outdoor air flow rate shall be increased to the minimum outdoor air flow rates indicated in Contract Schedules, via modulating the minimum OA damper and EA damper back to 100% open.

3) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoor levels or greater than 900 ppm or greater than 5 minutes, after contract minimum outdoor air has been provided, the maximum outdoor air damper shall modulate open and indicate an alarm at the BMS.

4) Upon a reduction in carbon dioxide levels below prescribed levels indicated above, for a minimum of 5 minutes, the maximum air damper shall close.

3.3 TYPICAL SINGLE-ZONE CONSTANT VOLUME AC UNIT WITH CHILLED WATER COIL (AC-3, AC-8, AC-9, AC-11, AC-12).

A. System

1. Description and Start-up

a. Constant volume air handling unit with a supply and return fan. Heating shall be via a low pressure steam pre-heat coil and primary heating coil. Cooling shall be via a chilled water cooling coil.

b. Unit shall operate on a time of day schedule in conjunction with preset settings defined within summer and winter modes. Additionally, the BMS shall have to ability to over-ride (if applicable) and engage the system.

c. When available, unit shall be able to engage economizer mode to provide free cooling and enter into demand-control ventilation to maintain acceptable CO2 levels with reduced OA.

2. Preheat coil:

a. When the supply and return fans are operating, and the preheat coil discharge temperature is less than 45 deg F (adj.), the preheat control valve shall modulate open to maintain 45 deg F (adj.) preheat coil discharge temperature.

b. When the supply and return fans are not operating, and the outdoor temperature sensor in the OA intake plenum is less than 40 deg F (adj.), the preheat control valve shall modulate open to maintain 45 deg F (adj.) plenum temperature.

3. Safeties.

a. Fire alarm: When signaled by the fire alarm system the supply fan and return fan shall shutdown; Dampers and valves shall positions to their fail safe positions. A signal shall be generated at the BMS.

b. Freezestat: Preheat coil shall have a freezestat to prevent the downstream coils from freezing. When the preheat coil discharge temperature drops below 36 deg F (adj.), the unit shall shut off. Manual reset shall be required.

c. HL and LL Alarms: See point map for respective unit for high level and low level alarms.

d. Monitoring: See point map for respective unit for points to be monitored on the BMS.

B. Operation

1. Summer/Winter mode shall operate based on outdoor temperatures as follows. The BMS shall have the ability to over-ride the OA temperature-based method to engage either mode.

2. Summer mode: When the temperature outside is greater than 60 deg F (adj.), the unit shall be placed into summer mode. The heating coil control valve shall remain closed during summer mode operation.

a. Cool-down mode (unoccupied)

1) Based upon outdoor and indoor temperatures, the controller shall schedule an optimum time to engage cool-down mode prior to operating in cooling mode. Additionally, the system shall operate in cool-down mode upon a demand from the BMS.

2) The minimum and maximum OA damper and the minimum and maximum EA damper shall remain closed during cool-down mode operation; the RA damper shall remain open. The SA and RA fans shall be energized. The cooling coil valve shall modulate to maintain a discharge temperature 55 deg F (adj.). Once the space temperature has reached 78 deg F (adj.) the cooling coil valve shall begin to close slowly until the space temperature has reach 75 deg F (adj.). The unit shall then enter cooling mode.

3) When the outside air temperature is 10 deg F (adj., recommended minimum indicated) cooler than the space temperature and wet bulb is 63°F or less, the unit shall use the economizer dampers to purge the space and achieve complete or partial cool-down. Both OA dampers and both EA dampers shall open; the RA damper shall close.

b. Cooling Mode (occupied)

1) The minimum OA damper and EA damper shall open. The maximum OA damper and EA damper shall remain closed. The RA damper shall remain open. Dampers shall remain in this position unless economizer operation or DCV sequence overrides.

2) SA and RA fan shall be energized and remain operational during cooling mode operation.

3) Economizer operation shall be the first method of cooling if conditions are met as per Economizer Mode section, below.

4) The space temperature shall be maintained by modulating the cooling coil control valve. The PID loop shall have a 5 deg F (adj.) dead band to prevent

overshoot. The cooling coil control valve shall modulate to maintain a discharge temperature of 55 deg F (adj.) supply air when the space temperature is above the set point temperature of 75 deg F (adj.).

5) System shall operate in cooling mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

3. Winter Mode: When the outside air temperature is less than 55 deg F (adj.), the unit shall be placed into winter mode. The cooling coil control valve shall remain closed during winter mode operation. The unit shall operate in occupied or unoccupied heating mode as per time of day schedule or as per command from BMS.

4. Heating mode (unoccupied)

   a. OA and EA dampers shall be closed. RA damper shall be open.

   b. Space temperature shall be monitored at unoccupied times.

   c. When any space temperature drops below 55 deg F (adj.), the SA and RA fans shall be energized. The heating coil control valve shall modulate to maintain a supply air temperature of 75 deg F.

   d. When the space temperature has reached 63 deg F (adj.), the SA and RA fans shall be de-energized. The heating coil control valve shall modulate closed.

   e. When engaged, this mode shall operate for a minimum of 5 minutes.

5. Warm-up mode

   a. Based upon outdoor and indoor temperatures, the controller shall schedule an optimum time to engage warm-up mode prior to operating in heating mode. Additionally, the system shall operate in warm-up mode upon a demand from the BMS.

   b. The minimum and maximum OA damper and the minimum and maximum EA damper shall remain closed during warm-up mode operation; the RA damper shall remain open. The SA and RA fans shall be energized. The heating coil control valve shall modulate to maintain a discharge temperature of

90 deg F (adj.). Once the space temperature has reached 68 deg F (adj.) the heating coil valve shall begin to close slowly until the space temperature has reach 72 deg F (adj.). The unit shall then enter heating mode.

6. Heating mode (occupied)

   a. The minimum OA damper and EA damper shall open. The maximum OA damper and EA damper shall remain closed. The RA damper shall remain open. Dampers shall remain in this position unless economizer operation or DCV sequence overrides.

   b. SA and RA fan shall be energized and remain operational during occupied heating mode operation.

   c. The system shall operate in economizer cooling operation when any space temperature rises above 77 deg F (adj.). See Economizer Mode for sequence.

   d. The space temperature shall be maintained by modulating the heating coil control valve. The heating coil control valve shall modulate to maintain a discharge temperature of 85 deg F (adj.) supply air when the space temperature is 65 deg F (adj.) or below. The heating coil control valve shall modulate to maintain a discharge temperature of 70 deg F (adj.) supply air when the space temperature is above 65 deg F (adj.).

   e. The PID loop shall have a 5 deg F (adj.) dead band to prevent overshoot.

   f. System shall operate in heating mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

7. Economizer Mode:

   a. Economizer Mode (Cooling Mode):

      1) When the system is in Cooling Mode, the Economizer Mode shall be used as the first method of cooling. When the outside air temperature is between 55 deg F (adj.) and 65 deg F (adj.) and the OA enthalpy is less than the RA enthalpy, the system shall operate in

Economizer Mode. The minimum OA damper and EA damper shall remain open.

2) The maximum OA and EA dampers shall modulate open in conjunction with the chilled water control valve when needed, to maintain the required discharge air temperature.

3) When the maximum OA and EA dampers are open 100%, the RA damper shall close.

b. Economizer Mode - Heating Mode, Occupied

1) When the system is in Heating Mode (occupied), the Economizer Mode shall function as "free cooling" when one of the spaces served by the system requires cooling. The minimum OA damper and EA damper shall remain open.

2) The system shall operate in economizer cooling operation when any space temperature rises above 77 deg F (adj.) and the outdoor temperature is equal to or below 60 deg F (adj.).

3) The maximum outdoor air damper shall modulate open to maintain a discharge air temperature of 60 deg F (adj.). When any space temperature reaches 82 deg F (adj.), the maximum outdoor air damper shall modulate to maintain a discharge air temperature of 55 deg F (adj.). The maximum EA damper shall modulate with the maximum OA damper.

4) Economizer free cooling shall be disengaged when there is no longer any space temperature above 77 deg F (adj.) or when the mixed air temperature is below of 50 deg F (adj.).

c. Demand Control Ventilation (DCV):

1) Upon unit start-up, system shall operate in normal occupied mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

2) DCV shall over-ride minimum OA damper and EA damper controls in occupied mode.

d. DCV Damper Control

1) If all the space and duct sensor carbon dioxide levels are less than 500ppm above outdoor levels, and less than 900 ppm overall, for a minimum of 5 minutes, then the outdoor air flow rate shall be reduced to 50% of minimum outdoor flow rate indicated in Contract Schedules, via modulating the minimum OA damper and EA damper.

2) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoors levels or greater than 900 ppm overall, the outdoor air flow rate shall be increased to the minimum outdoor air flow rates indicated in Contract Schedules, via modulating the minimum OA damper and EA damper back to 100% open.

3) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoor levels or greater than 900 ppm or greater than 5 minutes, after contract minimum outdoor air has been provided, the maximum outdoor air damper shall modulate open and indicate an alarm at the BMS.

4) Upon a reduction in carbon dioxide levels below prescribed levels indicated above, for a minimum of 5 minutes, the maximum air damper shall close.

3.4 TYPICAL SINGLE-ZONE CONSTANT VOLUME AC UNIT WITH CHILLED WATER COIL (AC-3).

A. System

1. Description and Start-up

a. Constant volume air handling unit with a supply and return fan. Heating shall be via a low pressure steam pre-heat coil and primary heating coil. Cooling shall be via a chilled water cooling coil.

B. Operation

1. Contractor shall obtain the complete sequence of operations from the existing system controller prior to disconnection and removal of the existing controller. This sequence of operations shall dictate the existing operation of the complete system in heating/cooling mode, warm-up/cool-down mode, economizer mode, all safeties, and all modes of operation that are currently programmed into the controller. Provide written sequences to Commissioner.

2. Following installation of new controller, contractor shall program controller to exactly execute all sequences of operations obtained from the previously existing controller.

3. Additional sequence of operation:

   a. Demand Control Ventilation (DCV):

      1) Upon unit start-up, system shall operate in normal occupied mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

      2) DCV shall over-ride minimum OA damper and EA damper controls in occupied mode.

      3) DCV Damper Control

         a) If all the space and duct sensor carbon dioxide levels are less than 500ppm above outdoor levels, and less than 900 ppm overall, for a minimum of 5 minutes, then the outdoor air flow rate shall be reduced to 50% of minimum outdoor flow rate indicated in Contract Schedules, via modulating the minimum OA damper and EA damper.

         b) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoors levels or greater than 900 ppm overall, the outdoor air flow rate shall be increased to the minimum outdoor air flow rates indicated in Contract Schedules, via modulating the minimum OA damper and EA damper back to 100% open.

c) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoor levels or greater than 900 ppm or greater than 5 minutes, after contract minimum outdoor air has been provided, the maximum outdoor air damper shall modulate open and indicate an alarm at the BMS.

d) Upon a reduction in carbon dioxide levels below prescribed levels indicated above, for a minimum of 5 minutes, the maximum air damper shall close.

3.5 MULTI-ZONE CONSTANT VOLUME UNIT WITH CHILLED WATER COIL (AC-1).

A. System

1. System Description and Start-up

a. Constant volume multi-zone air handling unit with a supply fan and separate exhaust fan. Supply air conditions are maintained by mixing hot deck air and cold deck air, where the off-season deck serves as bypass. Preliminary heating shall be via a low pressure steam pre-heat coil ahead of the hot/cold deck arrangement. Hot deck heating shall be via low pressure steam. Cold deck cooling shall be via a chilled water cooling coil. During Winter Mode operation, the cooling coil control valve remains closed. During the Summer Mode operation, the heating coil control valve remains closed.

B. Operation

1. Contractor shall obtain the complete sequence of operations from the existing system controller prior to disconnection and removal of the existing controller. This sequence of operations shall dictate the existing operation of the complete system in heating/cooling mode, warm-up/cool-down mode, economizer mode, all safeties, and all modes of operation that are currently programmed into the controller. Provide written sequences to Commissioner.

2. Following installation of new controller, contractor shall program controller to exactly execute all sequences of operations obtained from the previously existing controller.

3. Additional sequence of operation:

   a. Demand Control Ventilation (DCV):

      1) Upon unit start-up, system shall operate in normal occupied mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

      2) DCV shall over-ride minimum OA damper and EA damper controls in occupied mode.

      3) DCV Damper Control

         a) If all the space and duct sensor carbon dioxide levels are less than 500ppm above outdoor levels, and less than 900 ppm overall, for a minimum of 5 minutes, then the outdoor air flow rate shall be reduced to 50% of minimum outdoor flow rate indicated in Contract Schedules, via modulating the minimum OA damper and EA damper.

         b) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoors levels or greater than 900 ppm overall, the outdoor air flow rate shall be increased to the minimum outdoor air flow rates indicated in Contract Schedules, via modulating the minimum OA damper and EA damper back to 100% open.

         c) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoor levels or greater than 900 ppm or greater than 5 minutes, after contract minimum outdoor air has been provided, the maximum outdoor air damper shall modulate open and indicate an alarm at the BMS.

         d) Upon a reduction in carbon dioxide levels below prescribed levels indicated above, for a minimum of 5 minutes, the maximum air damper shall close.

3.6 CONSTANT VOLUME AHU-B-1 SYSTEM

A. System

1. Description and Start-up

a. Constant volume modular air handling unit with a supply and return fan and heat wheel. Heating shall be via a low pressure steam heating coil. Cooling shall be via a chilled water cooling coil.

b. This AHU also serves for post-fire smoke purge.

B. Operation

1. Contractor shall obtain the complete sequence of operations from the existing system controller prior to disconnection and removal of the existing controller. This sequence of operations shall dictate the existing operation of the complete system in heating/cooling mode, warm-up/cool-down mode, economizer mode, heat recovery sequence, smoke purge sequence, all safeties, and all modes of operation that are currently programmed into the controller. Provide written sequences to Commissioner.

2. Following installation of new controller, contractor shall program controller to exactly execute all sequences of operations obtained from the previously existing controller.

3. Additional sequence of operation:

a. Demand Control Ventilation (DCV):

1) Upon unit start-up, system shall operate in normal occupied mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

2) DCV shall over-ride OA damper and EA damper control in occupied mode.

3) DCV Damper Control

a) If all the space and duct sensor carbon dioxide levels are less than 500ppm above outdoor levels, and less than 900 ppm overall, for a minimum of 5 minutes, then the outdoor air

damper shall modulate to the 25% open position.

b) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoors levels or greater than 900 ppm overall, the outdoor air damper shall modulate from 25% open position to 65% minimum position.

c) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoor levels or greater than 900 ppm or greater than 5 minutes, after contract minimum outdoor air has been provided, the outdoor air damper shall modulate open and indicate an alarm at the BMS.

d) Upon a reduction in carbon dioxide levels below prescribed levels indicated above, for a minimum of 5 minutes, the outdoor air damper shall return to minimum position.

3.7 VARIABLE AIR VOLUME AHU-B-2 SYSTEM

A. System

1. Description and Start-up

a. Variable air volume modular air handling unit with a supply and return fan. Heating shall be via a low pressure steam heating coil. Cooling shall be via a chilled water cooling coil. Variable volume control is achieved through VAV boxes.

B. Operation

1. Contractor shall obtain the complete sequence of operations from the existing system controller prior to disconnection and removal of the existing controller. This sequence of operations shall dictate the existing operation of the complete system in heating/cooling mode, warm-up/cool-down mode, economizer mode, all safeties, and all modes of operation that are currently programmed into the controller. Provide written sequences to Commissioner.

2. Following installation of new controller, contractor shall program controller to exactly execute all sequences of operations obtained from the previously existing controller.

3. Additional sequence of operation:

   a. Demand Control Ventilation (DCV):

      1) Upon unit start-up, system shall operate in normal occupied mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

      2) DCV shall over-ride OA damper and EA damper control in occupied mode.

      3) DCV Damper Control

         a) If all the space and duct sensor carbon dioxide levels are less than 500ppm above outdoor levels, and less than 900 ppm overall, for a minimum of 5 minutes, then the outdoor air damper shall modulate to the 25% open position.

         b) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoors levels or greater than 900 ppm overall, the outdoor air damper shall modulate from 25% open position to 65% minimum position.

         c) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoor levels or greater than 900 ppm or greater than 5 minutes, after contract minimum outdoor air has been provided, the outdoor air damper shall modulate open and indicate an alarm at the BMS.

         d) Upon a reduction in carbon dioxide levels below prescribed levels indicated above, for a minimum of 5 minutes, the outdoor air damper shall return to minimum position.

3.8 CONSTANT VOLUME OA HEATING AND VENTILATING UNIT (H-1).

A. System

1. Description and Start-up

a. Constant volume air handling unit with a supply fan and return plenum. Heating shall be via a hot water heating coil.

b. Unit shall operate on a time of day schedule in conjunction with preset settings defined within summer and winter modes. Additionally, the BMS shall have to ability to over-ride (if applicable) and engage the system.

2. Safeties.

a. Fire alarm: When signaled by the fire alarm system the supply fan and return fan shall shutdown; Dampers and valves shall positions to their fail safe positions. A signal shall be generated at the BMS.

b. Freezestat: Preheat coil shall have a freezestat to prevent the downstream coils from freezing. When the preheat coil discharge temperature drops below 36 deg F (adj.), the unit shall shut off. Manual reset shall be required.

c. HL and LL Alarms: See point map for respective unit for high level and low level alarms.

d. Monitoring: See point map for respective unit for points to be monitored on the BMS.

B. Operation

1. Summer Mode: The unit shall operate on a fixed ventilation schedule as per CFM requirements of the unit. During operation the OA dampers shall remain open. Heating valves shall remain closed.

2. Winter Mode: When the outside air temperature is less than 55 deg F (adj.), the unit shall be placed into winter mode. The unit shall operate in occupied or unoccupied heating mode as per time of day schedule or as per command from BMS.

a. Heating mode (unoccupied)

1) OA damper shall be closed. Space temperature shall be monitored at unoccupied times.

2) When any space temperature drops below 55 deg F (adj.), the SA fan shall be energized. The OA damper shall open. The heating coil control valves shall modulate to maintain a supply air temperature of 75 deg F.

3) When the space temperature has reached 63 deg F (adj.), the SA fan shall be de-energized. The heating coil control valve shall modulate closed.

4) When engaged, this mode shall operate for a minimum of 5 minutes.

b. Warm-up mode

1) Based upon outdoor and indoor temperatures, the controller shall schedule an optimum time to engage warm-up mode prior to operating in heating mode. Additionally, the system shall operate in warm-up mode upon a demand from the BMS.

2) The OA damper shall remain open during warm-up mode operation. The SA fan shall be energized. The heating coil control valve shall modulate to maintain a discharge temperature of 90 deg F (adj.). Once the space temperature has reached 68 deg F (adj.) the heating coil valve shall begin to close until the space temperature has reach 72 deg F (adj.). The unit shall then enter heating mode.

c. Heating mode (occupied)

1) The OA damper shall remain open.

2) SA fan shall be energized and remain operational during occupied heating mode operation.

3) The space temperature shall be maintained by modulating the heating coil control valve. The heating coil control valve shall modulate to maintain a discharge temperature of 85 deg F (adj.) supply air when the space temperature is 65 deg F (adj.) or below. The heating coil control valve shall modulate to maintain a discharge temperature of 70 deg F

(adj.) supply air when the space temperature is above 65 deg F (adj.).

4) The PID loop shall have a 5 deg F (adj.) dead band to prevent overshoot.

5) System shall operate in heating mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

3.9 CONSTANT VOLUME 100% OA HEATING AND VENTILATING UNIT (S-1).

A. System

1. Description and Start-up

a. Constant volume air handling unit with a supply and exhaust fan. Heating shall be via a low pressure steam heat coil that contains two control valves.

b. Unit shall operate on a time of day schedule in conjunction with preset settings defined within summer and winter modes. Additionally, the BMS shall have to ability to over-ride (if applicable) and engage the system.

2. Safeties.

a. Fire alarm: When signaled by the fire alarm system the supply fan and return fan shall shutdown; Dampers and valves shall positions to their fail safe positions. A signal shall be generated at the BMS.

b. Freezestat: Preheat coil shall have a freezestat to prevent the downstream coils from freezing. When the preheat coil discharge temperature drops below 36 deg F (adj.), the unit shall shut off. Manual reset shall be required.

c. HL and LL Alarms: See point map for respective unit for high level and low level alarms.

d. Monitoring: See point map for respective unit for points to be monitored on the BMS.

B. Operation

1. Summer Mode: The unit shall operate on a fixed ventilation schedule as per CFM requirements of the unit. During operation the

exhaust and OA dampers shall remain open. Heating valves shall remain closed.

2. Winter Mode: When the outside air temperature is less than 55 deg F (adj.), the unit shall be placed into winter mode. The unit shall operate in occupied or unoccupied heating mode as per time of day schedule or as per command from BMS.

   a. Heating mode (unoccupied)

      1) OA and EA dampers shall be closed. Space temperature shall be monitored at unoccupied times.

      2) When any space temperature drops below 55 deg F (adj.), the SA and EA fans shall be energized. The heating coil control valve shall modulate to maintain a supply air temperature of 75 deg F.

      3) When the space temperature has reached 63 deg F (adj.), the SA and EA fans shall be de-energized. The heating coil control valve shall modulate closed.

      4) When engaged, this mode shall operate for a minimum of 5 minutes.

   b. Warm-up mode

      1) Based upon outdoor and indoor temperatures, the controller shall schedule an optimum time to engage warm-up mode prior to operating in heating mode. Additionally, the system shall operate in warm-up mode upon a demand from the BMS.

      2) The OA damper and the EA damper shall remain open during warm-up mode operation. The SA and RA fans shall be energized. The heating coil control valve shall modulate to maintain a discharge temperature of 90 deg F (adj.). Once the space temperature has reached 68 deg F (adj.) the heating coil valve shall begin to close until the space temperature has reach 72 deg F (adj.). The unit shall then enter heating mode.

   c. Heating mode (occupied)

      1) The OA damper and EA damper remain shall open.

2) SA and EA fan shall be energized and remain operational during occupied heating mode operation.

3) The space temperature shall be maintained by modulating the heating coil control valve. The heating coil control valve shall modulate to maintain a discharge temperature of 85 deg F (adj.) supply air when the space temperature is 65 deg F (adj.) or below. The heating coil control valve shall modulate to maintain a discharge temperature of 70 deg F (adj.) supply air when the space temperature is above 65 deg F (adj.).

4) The PID loop shall have a 5 deg F (adj.) dead band to prevent overshoot.

5) System shall operate in heating mode for minimum of 5 min before initiating the Demand Controlled Ventilation sequence, even if conditions are met.

3.10 PACKAGED VARIABLE AIR VOLUME RTU-1 AND RTU-2 SYSTEM

A. System

1. Description and Start-up

a. Packaged variable air volume rooftop unit with a supply and return fan. Electric resistance heating; direct expansion cooling. Variable volume control is achieved through VAV boxes.

2. Safeties.

a. Fire alarm: When signaled by the fire alarm system the system shall shutdown. A signal shall be generated at the BMS.

3. Operation

a. System ON:

1) System ON shall be selectable through manual operator input at the BMS workstation, and via a preprogrammed schedule. "System ON" shall function as "System AUTO", and shall energize the system fans, system controller, and control circuit, which

shall enable the execution of system cooling, heating, and all control mode sequences automatically.

b. System OFF:

1) System OFF shall be selectable through manual operator input at the BMS workstation, and via a preprogrammed schedule. "System OFF" shall de-energize system fans, system controller, and control circuit, unless BMS reads "Cooling Compressor ON" status, in which case the BMS will allow completion of cooling cycle and additional 2-3 minutes (adj.) before system shutdown.

3.11 VARIABLE AIR VOLUME AHU-6A AND AHU-6B SYSTEM

A. System

1. Description and Start-up

a. Variable air volume modular air handling unit with a supply and return fan. Heating shall be via a low pressure steam heating coil. Cooling shall be via a chilled water cooling coil. Variable volume control is achieved through VAV boxes.

B. Operation

1. Contractor shall obtain the complete sequence of operations from the existing system controller prior to disconnection and removal of the existing controller. This sequence of operations shall dictate the existing operation of the complete system in heating/cooling mode, warm-up/cool-down mode, economizer mode, all safeties, and all modes of operation that are currently programmed into the controller. Provide written sequences to Commissioner.

2. Following installation of new controller, contractor shall program controller to exactly execute all sequences of operations obtained from the previously existing controller.

3. Additional sequence of operation:

a. Demand Control Ventilation (DCV):

1) Upon unit start-up, system shall operate in normal occupied mode for minimum of 5 min before initiating

the Demand Controlled Ventilation sequence, even if conditions are met.

2) DCV shall over-ride OA damper and EA damper control in occupied mode.

3) DCV Damper Control

a) If all the space and duct sensor carbon dioxide levels are less than 500ppm above outdoor levels, and less than 900 ppm overall, for a minimum of 5 minutes, then the outdoor air damper shall modulate to the 25% open position.

b) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoors levels or greater than 900 ppm overall, the outdoor air damper shall modulate from 25% open position to 65% minimum position.

c) If any of the space or duct carbon dioxide levels are greater than 500 ppm above outdoor levels or greater than 900 ppm or greater than 5 minutes, after contract minimum outdoor air has been provided, the outdoor air damper shall modulate open and indicate an alarm at the BMS.

d) Upon a reduction in carbon dioxide levels below prescribed levels indicated above, for a minimum of 5 minutes, the outdoor air damper shall return to minimum position.

3.12 MISCELLANEOUS DX AIR HANDLING UNITS (AHU-1, AHU-2, AHU-3, AHU-19, FCU)

A. System

1. Description and Start-up

a. Miscellaneous direct expansion ac units.

B. Operation

1. Contractor shall obtain the complete sequence of operations from the existing system controller prior to disconnection and removal of the existing controller. This sequence of operations shall dictate the existing operation of the complete system in heating/cooling mode, warm-up/cool-down mode, economizer mode, all safeties, and all modes of operation that are currently programmed into the controller. Provide written sequences to Commissioner.

2. Following installation of new controller, contractor shall program controller to exactly execute all sequences of operations obtained from the previously existing controller.

3.13 MISCELLANEOUS EQUIPMENT CONTROL PANELS (AIR-COOLED CHILLER/PUMP SERVING AHU-B-1 & AHU-B-2)

A. System

1. Description and Start-up

a. Air-cooled chiller and associated pumps.

B. Operation

1. Contractor shall obtain the complete sequence of operations from the existing air-cooled chiller plant controller prior to disconnection and removal of the existing controller. This sequence of operations shall dictate the existing operation of the complete chiller plant including chiller, pumps, equipment staging, lead/lag sequences, all operating and programmed setpoints, all safeties, and all modes of operation that are currently programmed into the controller. Provide written sequences to Commissioner.

2. Following installation of new controller, contractor shall program controller to exactly execute all sequences of operations obtained from the previously existing controller.

3.14 SEQUENCE OF OPERATION FOR TYPICAL VAV BOX

A. Operation:

1. Unoccupied mode

a. When the Air handling unit that serves the VAV box is in unoccupied mode, than the VAV box shall be in unoccupied mode. Dampers and reheat valves shall be placed in their fail-safe position.

2. Occupied mode:

a. When the Air handling unit that serves the VAV box is in occupied mode, than the VAV box shall be in occupied mode.

b. Warm-up

1) When the Air handling unit that serves the VAV box enters warm-up mode than the VAV damper shall fully open. When the temperature setpoint is met as sensed by the associated VAV temperature stat, then the VAV box shall enter heating mode.

c. Heating Mode

1) VAV box shall enter heating mode when the space temperature drops below setpoint.

2) VAV damper shall modulate to maintain CFM as sensed by the air flow probes.

d. Cool-down mode

1) When the Air handling unit that serves the VAV box enters cool-down mode than the VAV damper shall fully open. When the temperature setpoint is met as sensed by the associated VAV temperature stat, then the VAV box shall enter cooling mode.

e. Cooling Mode

1) VAV box shall enter cooling mode when the space temperature goes above setpoint.

2) VAV damper shall modulate to maintain CFM as sensed by the air flow probes.

3.15 SEQUENCE OF OPERATION FOR TYPICAL VAV BOX W/ REHEAT COIL

A. Operation:

1. Unoccupied mode

   a. When the Air handling unit that serves the VAV box is in unoccupied mode, than the VAV box shall be in unoccupied mode. Dampers and reheat valves shall be placed in their fail-safe position.

2. Occupied mode:

   a. When the Air handling unit that serves the VAV box is in occupied mode, than the VAV box shall be in occupied mode.

   b. Warm-up

      1) When the Air handling unit that serves the VAV box enters warm-up mode than the VAV damper shall fully open and the valve serving the reheat coil shall fully open. When the temperature setpoint is met as sensed by the associated VAV temperature stat, then the VAV box shall enter heating mode.

   c. Heating Mode

      1) VAV box shall enter heating mode when the space temperature drops below setpoint.

      2) VAV damper shall modulate to maintain CFM as sensed by the air flow probes.

      3) The reheat coil valve shall modulate to maintain a discharge temperature of 80 deg F (adj.).

   d. Cool-down mode

      1) When the Air handling unit that serves the VAV box enters cool-down mode, the VAV damper shall fully open and the valve serving the reheat coil shall fully close. When the temperature setpoint is met as sensed by the associated VAV temperature stat, then the VAV box shall enter cooling mode.

e. Cooling Mode

1) VAV box shall enter cooling mode when the space temperature goes above setpoint.

2) VAV damper shall modulate to maintain CFM as sensed by the air flow probes.

3) The reheat coil valve shall remain closed during cooling.

3.16 SEQUENCE OF OPERATION FOR TYPICAL VAV BOX W/ ELECTRIC HEAT

A. Operation:

1. Unoccupied mode

a. When the Air handling unit that serves the VAV box is in unoccupied mode, than the VAV box shall be in unoccupied mode. Dampers shall be placed in their fail-safe position and electric heat shall remain off.

2. Occupied mode:

a. When the Air handling unit that serves the VAV box is in occupied mode, than the VAV box shall be in occupied mode.

b. Warm-up

1) When the Air handling unit that serves the VAV box enters warm-up mode than the VAV damper shall fully open and the electric heat coil shall turn-on. When the temperature setpoint is met as sensed by the associated VAV temperature stat, then the VAV box shall enter heating mode.

c. Heating Mode

1) VAV box shall enter heating mode when the space temperature drops below setpoint.

2) VAV damper shall modulate to maintain CFM as sensed by the air flow probes.

3) The electric heating coil shall turn-on.

d. Cool-down mode

1) When the Air handling unit that serves the VAV box enters cool-down mode, the VAV damper shall fully open and electric heat shall remain off. When the temperature setpoint is met as sensed by the associated VAV temperature stat, then the VAV box shall enter cooling mode.

e. Cooling Mode

1) VAV box shall enter cooling mode when the space temperature goes above setpoint.

2) VAV damper shall modulate to maintain CFM as sensed by the air flow probes.

3) Electric heat shall remain off during cooling.

3.17 SUPPLEMENTAL AC UNITS

A. AC units shall run 24 x 7 days a week and shall be under the control of the AC unit controller.

B. Status of AC units shall be monitored at BAS.

C. General Alarm shall be monitored at BAS.

D. Provide separate room temperature sensor and controller to monitor room temperature for alarm.

3.18 DIFFERENTIAL PRESSURE CONTROLLERS

A. A differential pressure controller, pipe to sense differential pressure between supply and return lines, shall control a bypass water valve to maintain an adjustable pressure differential between the supply and return lines. This device is existing for the chilled water system.

3.19 SEQUENCE OF OPERATION FOR A TYPICAL EXHAUST FANS.

A. Operation:

1. The exhaust fans shall continuously run. The building shall have the capability to start/stop the Exhaust fan at any time, as well as schedule a times of operation. When the Exhaust fan is running the associated damper shall open. The BMS shall monitor the run

status of the exhaust fan and indicate an alarm at the operator's workstation upon a fan failure.

3.20 ELECTRICAL AND MECHANICAL EQUIPMENT ROOM VENTILATION

A. A room thermostat shall cycle the exhaust fan and supply fan/supply air damper on and off to maintain desired conditions or a rise in temperature above 85°F (adjustable) fan shall start. When the fan starts, the outside air intake and spill air dampers shall open. When the fan stops, the dampers shall close.

B. Alarm shall be issued by BAS system when ventilation system fails or room temperature exceeds its setting.

3.21 NIGHT SET-BACK MODE FOR ALL HVAC SYSTEMS

A. A space temperature sensor shall cycle supply and return fan of each unit to maintain temperature sensor's setpoint whenever the AC system is not running but the space temperature falls below 50°F. When running under this mode, the outside air dampers shall stay closed and reheat coils active. In spaces served by the finned tube radiator, maintain 50°F temperature for perimeter zone. A space temperature sensor shall start the hot water pump.

3.22 PUMPS

A. Provide manual selector switch for pumps where indicated in design to enable selection of active pump wherever standby pumps are provided. All pumps shall have start/stop and status indication at the BAS.

3.23 SEQUENCE OF OPERATION FOR ROOF COOLING PLANT (COOLING TOWERS AND CHILLERS).

A. System Description

1. Description and Start-up

a. Three cooling towers serving three primary chillers. Each CT has two speed fan control. System contains four condenser water supply pumps, four primary loop chilled water pumps and two variable speed secondary loop chilled water pumps

B. Operation - Cooling Plant

1. Contractor shall obtain the complete sequence of operations from the existing chiller plant controller prior to disconnection and

removal of the existing controller. This sequence of operations shall dictate the existing operation of the complete chiller plant including chillers, cooling towers, pumps, heat tracing, refrigerant leak detection sequence, equipment staging, lead/lag sequences, all operating and programmed setpoints, all safeties, and all modes of operation that are currently programmed into the controller. Provide written sequences to Commissioner.

2. Following installation of new chiller plant controller, contractor shall program controller to exactly execute all sequences of operations obtained from the previously existing controller.

3. Additional sequence of operation:

   a. Chilled Water Reset:

      1) The BMS shall automatically reset the chilled water temperature setpoint based on the following outside air temperature reset schedule:

OAT	=	85°F	HWS	=	45°F
OAT	=	65°F	HWS	=	49°F

      Upon a rise in return air humidity level or return air enthalpy as determined by AHU RA temperature and humidity sensors, the BMS shall override CHW reset and revert to the low temperature (45F) chilled water supply setpoint until humidity/enthalpy setpoints are met.

3.24 SEQUENCE OF OPERATION FOR BOILER SYSTEM.

A. BMS shall monitor the following points:

1. Outside air temp
2. Steam pressure
3. Boiler #1 run status
4. Boiler #2 run status
5. Boiler #3 run status
6. Boiler stack temp
7. Boiler feed water valve

8. Boiler feed water pump
9. Condensate return temp
10. Condensate tank temp
11. Combustion fan status
12. Combustion damper status
13. Boiler common alarm
14. Boiler plant fuel-oil
15. Boiler plant fuel-gas
16. Natural gas alarm
17. Header gas pressure
18. Lead boiler indication
19. Lead boiler runtime
20. Series mode on
21. Parallel mode on
22. Boiler firing rate #1
23. Boiler firing rate #2
24. Boiler firing rate #3
25. Operating setpoint
26. Local (steam press) setpoint

B. Heating Hot Water Distribution:

1. Heating hot water is provided via the use of one steam to hot water converter.
2. Hot water discharge temperature shall be controlled via the use of one 1/3 and one 2/3 flow steam control valves to maintain variable discharge water in accordance with the following:

a. Hot water for perimeter zone radiators shall be scheduled with outside air temperature by modulating the steam control valves, in inverse proportion to schedule below:

OAT	=	0°F	HWS	=	180°F
OAT	=	60°F	HWS	=	120°F

3. When the heat exchanger is active, its water isolation control valve shall be open. The isolation control valve shall be closed when the heat exchanger is inactive.

4. The heat exchanger water isolation control valve and steam control valves shall open when any of the zone hot water pumps are operational.

5. Steam 1/3 and 2/3 control valves shall be modulated in sequence to maintain supply water temperature. 1/3 valve shall be fully open prior to modulating 2/3 valve open. Valves shall close in reverse when temperature is satisfied.

6. For heat exchangers serving solitary air handling unit, AHU-3, steam control valve shall be modulated to maintain hot water supply temperature.

7. The heating hot water distribution system is served by four individual 100% zone pumps with two standby pumps.

8. In the event a lead hot water pump fails, an alarm shall be signaled at the BMS. Common standby pump will be started manually and valves shall be opened and closed as required manually to use standby pump for hot water circulation.

9. The hot water pumps shall start through program, manually at BMS, or from the starter.

10. The control panel status of each pump shall be monitored by the DDC system. The common trouble or malfunction alarm shall be monitored by the DDC system.

11. The pump shall be commanded to start when the outdoor temperature falls below 60°F (adjustable) and there is a call for heating from the associated zone.

12. On a rise in air temperature above 60°F (adj.), the pump shall shut down.

3.25 VARIABLE FREQUENCY DRIVES (VFD)

A. VFD's shall have four distinct modes of operation:

1. OFF – VFD and motor are off.

2. HAND – VFD output is manually controlled via speed selector input on drive.

3. AUTO – VFD output is controlled by BAS.

4. BYPASS – Drive Electronics are bypassed and unit acts as an across-the-line-starter operating at 100% speed. This allows for maintenance of drive while motor is still operating.

B. VFD's shall have full communication capabilities with the BAS. Provide all interfaces, gateways, etc. as required for communications between the VFD's and BAS.

3.26 GAS/CO LEAK DETECTION SYSTEM:

A. Upon detection of gas and/or CO, the detection system shall signal alarm to the BMS.

END OF SECTION

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SECTION 23 21 16

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure gages.
2. Pressure gage taps.
3. Thermometers.
4. Termometer supports.
5. Test plugs.
6. Strainers.
7. Flow controls.

B. Related Sections:

1. Section 23 21 16 - Hydronic Piping Specialties: Product and installation requirements for piping specialties used in hydronic piping systems.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.
2. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

1.3 SUBMITTALS

A. General Conditions - Submittal Procedures: Submittal procedures.

B. Product Data: Submit for manufactured products and assemblies used in this Project.

1. Manufacturer's data indicating use, operating range, total range, accuracy, and location for manufactured components.

2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.

4. Submit electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and instrumentation, and flow controls.

B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.7 DELIVERY, STORAGE AND HANDLING

A. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.9 FIELD MEASUREMENTS

A. Verify field measurements before fabrication.

1.10 MAINTENANCE MATERIALS

A. Furnish two (2) bottles of red gage oil for static pressure gages.

1.11 EXTRA MATERIALS

A. Furnish two (2) pressure gages with pulsation damper dial thermometers.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Cast aluminum.

2. Bourdon Tube: Brass.

3. Dial Size: 4-1/2 inch (114 mm) and 8-1/2 inch (216 mm)] diameter.

4. Mid-Scale Accuracy: One percent.

5. Scale: Both psi and kPa.

2.2 PRESSURE GAGE TAPS

A. Needle Valve: Brass, 1/4 inch (6 mm) NPT for minimum 300 psi (2070 kPa).

B. Ball Valve: Stainless Steel, 1/8 inch (3 mm) NPT for 250 psi (1720 kPa).

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch (6 mm) NPT connections.

D. Siphon: Steel, Schedule 40, 1/4 inch (6 mm) NPT angle or straight pattern.

E. Scale ranges shall be:
Oil Pumps - 0 PSI to 125 PSI
Other Systems - 0 PSI to (2 x Operating Pressure) PSI
(Minimum 0 PSI to 30 PSI)

2.3 STEM TYPE THERMOMETERS

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Weksler

2. Taylor

3. Mueller

4. Substitutions: General Conditions - Product Requirements.

B. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch (229 mm) scale.

2. Window: Clear [glass] [Lexan].

3. Stem: Brass, 3-1/2 inch (89 mm) long.

4. Accuracy: ASTM E77 2 percent.

5. Calibration: Both degrees F and degrees C.

C. Scale ranges should be as follows:

Hot water	-	30°F to 240°F
Condenser water	-	20°F to 120°F
Chilled water	-	0°F to 100°F

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions[, and with cap and chain].

B. Flange: 3 inch (76 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

A. 1/4 inch (6 mm) NPT or 1/2 inch (13 mm) NPT brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with:

1. Neoprene core for temperatures up to 200 degrees F (93 degrees C).

2. Nordel core for temperatures up to 350 degrees F (176 degrees C).

3. Viton core for temperatures up to 400 degrees F (204 degrees C).

B. Test Kit:

1. Carrying case, internally padded and fitted containing:

a. Two 3-1/2 inch (89 mm) diameter pressure gages.

b. One gage adapters with 1/8 inch (3 mm) probes.

c. Two 1-1/2 inch (38 mm) dial thermometers.

1) Scale range: 0 to 200 degrees F (93 degrees C).

2.6 STRAINERS

A. Size 2 inch (50 mm) and Smaller:

1. Screwed brass, iron or steel body to suite the working pressure (minimum 175 psig), Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.

B. Size 2-1/2 inch (65 mm) to 4 inch (100 mm):

1. Flanged iron or steel body to suite the working pressure (minimum 175 psig), Y pattern with 3/64 inch (1.2 mm) stainless steel perforated screen.

C. Size 5 inch (125 mm) and Larger:

1. Flanged iron or steel body to suite the working pressure (minimum 175 psig), basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

2.7 AUTOMATIC FLOW CONTROL VALVES

A. In chilled water supply (inlet) pipe to each chilled water coil for all air handling units and all AC units, provide an automatic flow control valve as specified below:

1. Flow control valves shall be factory calibrated, direct acting, automatic pressure compensating type. Each valve shall limit flow rates to within ± 5 accuracy, regardless of system pressure fluctuations. Valve control mechanism shall consist of a tamper proof, brass or stainless steel cartridge assembly with open chambers and unobstructed flow passages. Cartridge assembly shall include a self-cleaning, spring-loaded moving cup guided at two separate points and shall utilize the full available differential pressure to actuate without hysterisis or binding. Differential pressure ranges shall be minimum 3 to 40 psig. Each valve to be provided with a metal tag, chain and stamped for system identification. Pressure taps and quick disconnect valves shall be provided with ferrous bodies. All hydronic system flow control valves shall be of one manufacturer. Flow control valves shall be Autoflow or Griswold and shall be of 250 psig design.

2. Furnish a portable flow measuring apparatus, complete with carrying case, pressure gauge, 3-way valve, hoses and connec-

tions. Unit to be compatible with automatic flow control valves to indicate pressure differential to determine flow rate through the valve.

PART 3 - EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.

1. In inlet and outlet of water coil.

2. In inlet and discharge side of each pump.

3. At each expansion tank.

4. At inlet and outlet of each cooling tower.

5. Inlet and outlet of each duplex oil strainer and condenser water filter.

6. Other locations as shown on the drawings.

7. At inlet and outlet of each chiller.

8. Inlet and outlet of each boiler.

B. Install gage taps in piping.

C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches (65 mm) for installation of thermometer sockets. Allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Install at the following locations:

1. In inlet and outlet water connections at each water coil bank in each air handling unit.

2. In inlet and outlet of hot water boilers.

3. Supply, return and mixed air duct of each air handling unit.

4. In supply and return water connection to each heating coil provide a thermometer and pressure gauge.

5. Inlet and outlet of each cooling tower.

6. Chilled water and condenser water header.

7. At other locations shown on drawings.

8. Inlet and outlet of each boiler and chiller.

F. Coil and conceal excess capillary on remote element instruments.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

A. Locate test plugs adjacent to thermometers and thermometer sockets and pressure gage taps as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

A. General Conditions - Quality Requirements,

B. Test for concentration of glycol and water solution and submit written test results.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not install hydronic pressure gauges until after systems are pressure tested.

END OF SECTION

SECTION 23 22 16

STEAM AND CONDENSATE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure gages.
2. Pressure gage taps.
3. Strainers.

B. Related Sections:

1. Section 23 05 03 - HVAC Piping: Execution requirements for piping connections to products specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

B. ASTM International:

1. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications.
2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
3. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
4. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

C. Underwriters Laboratories Inc.:

1. UL 8506 – Steam Generator System, Heat Recovery

2. UL 8501 – Boiler Operation.

1.3 PERFORMANCE REQUIREMENTS

A. Steam Traps: Not Used

1.4 SUBMITTALS

A. General Conditions - Submittal Procedures: Submittal procedures.

B. Product Data: Submit for manufactured products and assemblies used in this Project.

1. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.

2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of actual locations of components and instrumentation, flow controls and flow meters.

B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction and replacement parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.10 FIELD MEASUREMENTS

A. Verify field measurements before fabrication.

1.11 MAINTENANCE MATERIALS

A. Furnish two (2) bottles of red gage oil for static pressure gages.

1.12 EXTRA MATERIALS

A. Furnish two (2) pressure gages with pulsation damper.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's products that may be incorporated into the project:

1. Trerice.

2. Ashcroft

B. Gage: ASME B40.1 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Cast aluminum.

2. Bourdon Tube: Brass.

3. Dial Size: 4-1/2 inch (114 mm) and 8-1/2 inch (216 mm) diameter.

4. Mid-Scale Accuracy: One percent.

5. Scale: Both psi and kPa.

2.2 PRESSURE GAGE TAPS

A. Needle Valve: Brass, 1/4 inch (6 mm) NPT for minimum 300 psi (2070 kPa).

B. Ball Valve: Stainless Steel, 1/8 inch (3 mm) NPT for 250 psi (1720 kPa).

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch (6 mm) NPT connections.

D. Siphon: Steel, Schedule 40, 1/4 inch (6 mm) NPT angle or straight pattern.

E. Scale ranges shall be:

Steam Systems - 0 PSI to (2 x Operating Pressure) PSI
(Minimum 0 PSI to 30 PSI)

2.3 STRAINERS

A. Size 2 inch (50 mm) and Smaller:

1. Screwed iron body for 175 psig (1200 kPa) working pressure, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.

B. Size 2-1/2 inch (65 mm) to 4 inch (100 mm):

1. Flanged iron body for 175 psig (1200 kPa) working pressure, Y pattern with 3/64 inch (1.2 mm) stainless steel perforated screen.

C. Size 5 inch (125 mm) and Larger:

1. Flanged iron body for 175 psig (1200 kPa) working pressure, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

PART 3 - EXECUTION

3.1 INSTALLATION - GAGES

A. Install pressure gages with pulsation dampers. Provide ball valve to isolate each gage. Install siphon on gages in steam systems. Extend nipples and siphons to allow clearance from insulation.

B. Provide instruments with scale ranges selected according to service with largest appropriate scale.

C. Install gages in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

D. Adjust gages to final angle, clean windows and lenses, and calibrate to zero.

3.2 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not install steam pressure gauges until after systems are pressure tested.

END OF SECTION

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SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Duct Materials.
2. Casings.
3. Ductwork fabrication.
4. Duct cleaning.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

A. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
4. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

7. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

9. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Air Duct Leakage Test Manual.

2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

D. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

E. National Air Duct Cleaners Association

1. NADCA Standards for duct cleaning.

1.3 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size

round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

A. General Conditions - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 3/8 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.

2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.

3. Fittings.

4. Reinforcing details and spacing.

5. Seam and joint construction details.

6. Penetrations through fire rated and other walls.

7. Terminal unit, coil, and humidifier installations.

8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

9. Submit shop drawings indicating duct runs, material, extent of internal lining, fire dampers, volume dampers access doors and elevation of all ducts.

10. Also submit a book of Shop Standards for Sheetmetal Fabrication, for approval, before starting fabrication of any portion of ductwork.

C. Product Data: Submit data for duct materials, duct liner and duct connectors

D. Samples: Submit two (2) samples of typical shop fabricated duct fittings.

E. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Maintain one (1) copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by Commissioner.

1.8 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 DUCT MATERIALS

A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90/A90M.

B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

C. Stainless Steel Ducts: ASTM A167, Type 316.

D. Fasteners: Rivets, bolts, or sheet metal screws.

E. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 LONGITUDINAL SEAMS

A. Rectangular ducts shall be Pittsburgh lock with sealed pocket.

B. Welded ducts shall have butt-welded seams or lap (socket) welded seams to suite the sheet thickness.

2.3 CASINGS/PLENUMS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for operating pressures indicated.

B. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles. Furnish hinged access doors where indicated or required for access to equipment for cleaning and inspection.

C. Provide all metal housing, casings or plenums. Metal casings or plenums shall be constructed and jointed by external 1-1/2" standing seams of No. 16 USS gauge galvanized steel sheets, reinforced with 1-1/2" x 1-1/2" x 1/4" angles spaced not more than 3'-0" apart. Additional angles shall be provided wherever necessary to prevent vibration.

D. Bottom panels shall be constructed to form watertight pans not less than 6" deep, with brass drains with strainers and threaded outlets located in each compartment where required. The bottom of each compartment shall be pitched to the drain. Provide water seal in drain lines to carry lines to nearest indirect drain.

E. Casing or plenums shall be provided with steel supports, of type approved by Commissioner to properly support the equipment and to maintain pitch to the drains. Where insulated, they shall be arranged with adequate means of attaching the insulation, including the bottom, if any.

F. The Contractor shall provide heavy rigid plates with all required drilling and cutouts, heavy braced to reduce vibration, for the installation of thermometers, thermostats and other instruments.

G. Longitudinal reinforcing angles shall be installed on the inside in accordance with the following schedule:

Height of Side				Diagonal Bracing
Walls or Width of Roof	No. Angles	Angle Spanning	Length of Casing	Pairs of Braces
Up to 6'	0	-	Any	None
Up to 8'	1	Middle	Any	None
8' to 12'	2	1/3 points	Any	None
Over 12'	Variable	4' Centers	3&4 Panels	1
			5&6 Panels	2
			7&8 Panels	3

Angle size shall be 1-1/2" x 1-1/2" x 1/8" to 12' casing length, and 1-1/2" x 1/2" x 3/16" over 12' casing length.

NOTE: Provide knee-bracing for top of casing wherever required.

H. All joints shall be caulked with Minnesota Mining Formula EC 1057 or Alumastic to make them airtight.

I. Casing or plenums shall be supported on galvanized steel legs. The bottom at the floor and at any other connection to masonry shall be riveted to 1-1/2" x 1-1/2" x 1/8" galvanized steel angles which shall be secured to masonry with expansion shields and caulked tight with cement.

J. Provide angles above and below access doors and frames for access doors.

2.4 DOUBLE WALL PLENUMS

A. General:

1. Double-wall (insulated) pressurized plenum equipment enclosures shall be provided for all mixed air, return air and supply air discharge plenums. All panels and components shall be prefabricated and supplied by a nationally recognized manufacturer with published standards of construction, assembly and technical performance. The manufacturer shall have produced a

standardized prefabricated panel system for at least 10 years. Construction and performance of the installed system and components shall conform to all specifications listed in this document. The system and components shall not be susceptible to damage from extended exposure to airflow, pressure differentials, vibration, air temperature or humidity.

B. Joint Construction:

1. Panels shall be of "snap-lock" construction, such that adjacent panels are held together rigidly with an integral, continuous self-locking joint on both inside and outside panel surfaces. These joints shall not require screws, H-connectors, tape or any other type of additional fasteners or connectors.

2. For plenums in contact with air having temperature less than 60°F. during the summer, thermal break joints shall be provided.

C. Panel Construction:

1. All panels shall be 4 inches thick, with a solid galvanized steel exterior shell, and a perforated interior galvanized steel shell.

2. The outer and inner shells shall be tack or spot welded to perimeter and internal longitudinal steel channels and box-end internal closures, in such a manner and spacing that the panel assembly will not fail at the maximum operating loads specified in the Structural Performance specifications given in this document.

3. The outer shell shall be constructed of galvanized steel with a minimum 20-gauge thickness.

4. The inner shall be constructed of galvanized steel with a minimum 22-gauge thickness.

5. Perforated materials shall be 3/32-inch-diameter round holes with staggered spacing, 3/16 inch on center. The perforated material shall have a 23 percent open area.

6. All perimeter and internal longitudinal steel channel members shall be constructed of ASTM Type A-446 structural quality galvanized steel with a minimum 18-gauge thickness of ASTM Type A-526 commercial-quality galvanized steel with a minimum 16-gauge thickness.

7. All steel panel surfaces, internal channels, and trim items shall be fabricated from zinc-coated steel with a hot-dipped galvanized coating (minimum G-90 coating class as determined by ASTM A-525) and shall meet all requirements of ASTM A-526 for commercial-quality galvanized carbon steel.

8. Each panel assembly shall be completely filled with acoustical/thermal insulating material that is non-combustible, inert, mildew-resistant and vermin-proof. Insulation shall not settle within the panel assembly. No insulating materials shall be used that have a flame spread greater than 25 or a smoke developed greater than 50.

D. Components and Installation:

1. All plenum base channels shall be installed on a level concrete curb, the dimensions of which shall be determined from plan-view shop drawings of the system provided by the system manufacturer. Spacing of base channel attachments shall be as outlined in the manufacturer's standard details of assembly.

2. All assembly trim items shall be constructed of hot-dipped galvanized steel (minimum 18-gauge thickness) and furnished in standard lengths to be field cut to the required dimensions. Spacing of sheet metal screws, application of duct sealant and positioning of trim shall be in accordance with the plenum manufacturer's published erection and installation details.

3. All mechanical joints and external trim items shall be sealed with a UL-Classified duct sealant in accordance with manufacturer's recommendations. In order to show that joints have been sealed properly, enough sealant shall be used to that excess sealant is extruded from all completed external joints.

4. For enclosures to be installed indoors, joints and trim shall be sealed with a solvent-based duct sealant that is a polymeric rubber formulated to withstand temperatures from -20 to +150°F. Sealant shall be formulated such that surface preparation or solvent cleaning is not necessary. Sealant shall have a UL Classification marking with a flame spread of 15 and smoke developed of 20 when applied to 18-gauge galvanized steel and a flame spread of 10 and smoke developed of 0 when applied to organic reinforced cement board, both at a coverage of 31 square feet per gallon. Sealant shall exceed 750 hours without becoming brittle under ASTM-D572 test conditions (oxygen bomb).

5. For enclosures to be installed indoors and outdoors, joints and trim shall be sealed with a solvent-based duct sealant that is a neoprene-phenolic mastic formulated to withstand temperatures from 02- to +300°F. Sealant shall be formulated such that surface preparation or solvent cleaning is not necessary. Sealant shall have a UL Classification marking with a flame spread of 5 and smoke developed of 0 when applied to 18-gauge galvanized steel and a flame spread of 5 and smoke developed of 5 when applied to inorganic reinforced cement board, both at a coverage of 53 square feet per gallon. Sealant shall exceed 1,000 hours under ASTM-D572 test conditions (oxygen bomb) without becoming brittle under 500 hours in QUV accelerated-exterior-aging apparatus without degradation (under ASTM-C732 test conditions.

6. Personnel access doors shall be provided where specified on drawings and shall be 24 inches wide by 60 inches high unless otherwise indicated. All doors shall be the same nominal thickness as the prefabricated standard door panel in which they are mounted. All access door panels and doors shall be constructed with a solid inner and outer shall (minimum 20-gauge thickness). Each door shall be installed in the door panel at the factory and shall have a minimum of two ball-bearing hinges and two wedge-lever door latches. All levers shall be operable from the interior and exterior sides of the door panels. All doors shall be installed to open against the air pressure differential. Doors shall seat against neoprene gasket materials, installed around the entire perimeter of the door frame in such a manner that door operation will provide direct compression with no sliding action between the door and gasket.

7. Doors shall be furnished with windows, which are composed of double-glazed layers of wire-reinforced safety-glass, separated by an air space, and sealed against acoustical and air leakage by interior and exterior rubber seals.

8. Openings for pipe and conduits shall be field cut to ensure proper positioning. All framing members, collars and bellmouth fittings shall be insulated, welded and sealed according to the plenum manufacturer's published installation details.

E. Structural Performance:

1. The entire plenum installation shall be designed by the plenum manufacturer to be self-supporting. Where roof spans and wall

loadings require additional structural strength, it shall be provided by heavier panel skins, additional internal longitudinal reinforcing members or additional structural members and necessary supporting pipe columns. The installer shall furnish and install all structural members and pipe columns according to the drawings and published installation details provided by the plenum manufacturer.

2. The finished plenum installation shall be above to withstand a positive internal static pressure of 6 inches wg and a negative internal static pressure of 6 inches wg. Installations subjected to the effects of weather shall be able to withstand a wind loading of 100 pounds per square foot.

3. Under the conditions specified in the previous section, the assembled structure shall not exhibit any panel joint deflections in excess of L/200, where L is the unsupported span length of any panel section within the completed plenum.

F. Acoustical Performance:

1. The plenum manufacturer shall provide certified testing data obtained from an acoustical laboratory, listing sound absorption and transmission loss characteristics of the panel assembly. When requested by the Commissioner, the plenum manufacturer shall arrange to have a copy of all pertinent acoustical laboratory reports forwarded directly from the laboratory to the Commissioner.

2. When tested according to ANSI/ASTM C423-66 or a subsequent version of this standard, the panel assembly shall have minimum sound absorption coefficients, as shown in the following table, in the 1/3 octave band center frequencies. The coefficients used shall be those reported by the acoustical laboratory.

Sound Absorption Coefficients
1/3 Octave Band

Center Frequency (Hz)	125	250	500	1000	2000	4000	NEC
	0.63	1.09	1.17	1.08	1.03	0.97	1.00

3. When tested according to ANSI/ASTM E90-70 or a subsequent version of this standard, the panel assembly shall have minimum airborne sound transmission losses, as shown in the following table, in the combined full octave band center frequencies.

Sound Transmission Losses
Octave Band

Center Frequency (Hz)	125	250	500	1000	2000	4000	8000
	16	24	35	45	53	58	37

G. Thermal Performance:

1. Insulating materials used in all prefabricated panel assemblies shall have the following maximum thermal conductance at a mean temperature of 75°F: 0.06 Btu per hour per square foot per degree Fahrenheit.

2.5 ACCESS DOORS FOR CASING AND PLENUMS

A. Access doors not less than 20" x 48" shall be provided in equipment casings and plenums. They shall consist of No. 16 USS gauge galvanized steel sheets mounted on angle frames with crossbracing to prevent sagging or warping, and shall have sponge rubber gaskets.

Door shall be installed on angle or channel frames, extended where required to finish flush with insulation. In insulated casings, the doors shall be of double construction, filled with insulation 1" thick. Door openings in casings shall have angle frames to provide a true and uniform seating surface for the gasketed doors.

B. Each door shall be equipped with three (3) six screw "T" shaped extra heavy zinc plated hinges with brass pins as manufactured by Ferrum Co. No. 245 or approved equal. Provide three (3) cast zinc lever type fasteners. Ventlock No. 310 or approved equal. Inside release levers shall be provided for each door.

2.6 INSULATED PANELS

A. Provide insulated panels for all spaces to be blanked off inside fan housings and for unused portions of louvers and where noted on the drawings.

B. Inside and outside sheets of panels shall be constructed of alloy 25 hard aluminum sheet 20 B & S gauge. Insulation shall be 1-1/2" thick polyurethane.

C. Sections over 24" long shall be internally braced with inside Z-bars.

D. Panels shall be assembled and installed in such a manner as to be completely airtight and rigid.

2.7 DUCTWORK FABRICATION

A. Fabricate and support rectangular ducts in accordance with NYCBC, NYCMC, NFPA 96 and SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Ductwork shall be continuous, shall be built with joints and seams presenting a smooth surface on the inside and neatly finished on the outside. All joints and seams for supply, exhaust, make-up and return air ductwork shall be sealed airtight with approved non-hardening resilient caulking compound. "Airtight" shall mean duct leakage not exceeding 5% of design air quantity. Should duct leakage exceed this limit, Contractor shall reseal as required and rebalance systems at no cost to the Commissioner. ALL ductwork shall be sealed with high pressure duct sealant. Seal Class A, as defined by SMACNA, shall be provided for all ductwork.

C. Ductwork is exposed to view and considered an architectural component of the project. External tapes are not allowed and sealants/welds shall be finished in a workmanlike manner. All welding burns shall be filed and scraped clean. Excess sealants and filler material shall be removed. Duct supports shall have a finished appearance.

D. Fabricate ducts having pressure class equal to or greater than the static pressure of the fans or equipment to which the duct is connected.

E. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream unless noted otherwise.

G. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.

H. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

2.8 HANGERS AND SUPPORTS

A. Where hanger straps are used they shall be 1" x 18 ga. minimum, galvanized steel.

B. Rectangular duct risers shall be supported at each floor by angles or channels secured to the sides of the duct with welds, bolts, sheet metal screws or blind rivets.

C. Ducts over 60 inches wide shall be suspended on a trapeze type hanger. The duct shall not be secured to the hanger.

D. Hanger spacing shall vary between 4 ft. and 8 ft. depending on duct size and distance between construction joints, such that, 4 ft. sections shall be supported every 4 ft.

E. Provide inserts, fishplates and other methods recommended by SMACNA, and as approved, for supporting hanger straps and trapeze hangers. Do not use or submit power actuated fasteners, expansion nails or pins for supporting duct hangers.

2.9 DUCT SEALANTS

A. Use the following sealants for joints and seams and for acoustic lining and vapor barrier application to all ductwork unless called for otherwise:

B-F #30-02 for sealing high and low pressure ductwork
3M-425 for taping joints in vapor-proof barriers
B-F #85-20 for attaching acoustic lining
B-F #30-36 for binding edges on acoustic lining
B-F #30-35 as a vapor barrier cement on insulation

B. Use equivalent sealants if any of the above cannot provide flame spread rating of 25 and smoke developed rating 50 or less.

C. Duct sealants shall meet the latest VOC requirements of the South Coast Air Quality Management District (Rule #1168) and the content of VOC shall not exceed 250 grams per liter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

A. Install and seal ducts in accordance with NYCBC, NYCMC, NFPA 96 and SMACNA HVAC Duct Construction Standards - Metal and Flexible. All seams and joints shall be sealed to meet SMACNA Seal Class A.

B. During shipping, storage on-site and throughout construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system throughout the entire fabrication and installation process.

C. Provide internally insulated (lined) ductwork.

D. Use crimp joints with beaded sleeve couplings for joining round duct sizes 8 inch (200 mm) and smaller. Use flanged joints for ducts larger than 8 inches.

E. Install duct hangers and supports in accordance with Section 23 05 29.

F. Use double nuts and lock washers on threaded rod supports.

G. Set plenum doors 6 to 12 inches (150 to 300 mm) above floor. Arrange door swing so fan static pressure holds door in closed position.

H. Coordinate with all affected trades to insure that no ceilings, equipment or other materials other than as specifically provided herein are supported from ductwork or the ductwork hanger system.

I. Coordinate with others as necessary to insure that access doors have been provided in hung ceilings, shaft wall, or other construction, of ample size for proper operation and maintenance of the installation.

J. While the drawings shall be adhered to as closely as possible, the right is reserved to vary the run and size of ducts during the progress of the work if required to meet structural conditions.

K. Sheet metal sub-contractor shall consult with the sub-contractors and shall, in conjunction with the above contractors, establish the necessary space requirements for each trade. The sheet metal ductwork shall,

whether indicated or not, rise and/or drop and/or change in shape to clear any and all conduits, lighting fixtures, sprinklers, plumbing and heating piping to maintain the desired ceiling heights.

L. Transition pieces from rectangular to round at fan discharge shall be 16 gauge all-welded construction. Provide suitable angle reinforcement. Branches off medium and high pressure duct mains shall have conical taps.

M. Provide a fire damper and sheetmetal sleeve for each duct penetration through fire rated walls. Wherever ducts penetrate Mechanical Equipment Room walls, floor and ceiling slabs, and no fire smoke or fire damper is required, the entire space between duct and wall sleeve or slab opening shall be tightly packed with approved soundproof material. Each face of opening shall further be caulked airtight with approved non-hardening resilient caulking.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

3.4 DUCT PRESSURE TEST

A. Pressure Testing of Ductwork

1. Air pressure testing shall include separate air leakage tests of plenum and the horizontal distribution system ductwork. The testing shall apply to all ductwork in systems constructed to 3" w.g. or higher pressure classes.

2. Test all ductwork at corresponding pressure class to which it is constructed. Duct leakage shall be limited to the following:

Average Size of Run	100 ft. Run	
Diameter or Equivalent	(A	B)
12 inches or less	10	1"
20 inches or less	15	2"
30 inches or less	25	6"
40 inches or less	30	9"
50 inches or less	30	9"

(A) Permissible loss in cfm.

(B) Corresponding differential gauge reading (0.875 inch diameter orifice plate).

3. Tests shall be made prior to insulation of system being tested using suitable test equipment including "U" tube, orifice, tubing and cocks, arranged to indicate the amount of air leakage.

4. The leakage tests of the ductwork shall be made with pressure in the system, obtained by operation of the associated blower.

5. All joints shall be inspected and checked for audible leakage, repaired if necessary and retested.

6. Contractor shall test ductwork using SMACNA leakage test methods to limit amount of leakage per sq. ft. of ductwork prescribed for Leakage Class 6 or 6" WG Duct Design.

3.5 CLEANING

A. Scope of Work:

1. The Contractor shall provide all labor, materials, facilities, equipment and services to thoroughly clean HVAC system including supply air and exhaust ductwork, associated air devices, turning vanes, dampers, reheat coils, etc. The Contractor shall remove, store and re-install ceiling tiles as required for access to systems. The Contractor shall provide and install duct access doors as required for proper access. The Contractor shall repair or replace all damaged ceiling tiles, wall penetrations, ceiling penetrations, floor penetrations, insulation, control components or other damaged items to match existing.

2. Determine cleaning method to prevent damage to existing systems. Notify Commissioner of proposed method and impact on system prior to start. Also notify Commissioner of any system defects discovered during cleaning process.

B. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.

C. The duct system shall be inspected and certified by an air system cleaning specialist, member of NADCA, to confirm that it meets all NADCA standards.

3.6 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN

A. The Contractor shall incorporate all protective measures as required to prevent the contamination of the duct system and air distribution system. Air pollutants as described in the "SMACNA-IAQ Guidelines for Occupied Buildings Under Construction" Tables 2-2 and 2-3 shall be prevented from entering the duct system and air distribution system. Preventative measures including, but not limited to the following, shall be incorporated:

1. All stored ductwork and air distribution equipment shall be kept dry and clean.
2. Sealing of all ductwork and louvers prior to finish cleaning of building.
3. Utilization of temporary filters.
4. Sealing of fans, fan coil units, etc.
5. Duct and equipment cleaning.
6. Provisions for temporary construction exhaust fans to remove dust, odors, etc.
7. HVAC protection as defined in Chapter 3 of the above noted SMACNA manual.
8. Source control as defined in the above noted SMACNA manual.
9. Pathway interruption as defined in the above noted SMACNA manual.
10. Housekeeping as defined in the above noted SMACNA
11. Scheduling as defined in the above noted SMACNA manual.

B. Contractor shall coordinate all installation and develop construction Indoor Air Quality plan. Plan shall be submitted to Commissioner for review. Plan shall identify methods to prevent contamination of the duct system along with schedule/phasing issues.

C. If the Contractor does not meet the requirements of this section, the entire duct system shall be cleaned as noted in paragraph 3.5 of this Section.

D. It is the intent that the permanent HVAC systems will not be used for temporary heating and cooling. Contractors shall provide temporary heating and cooling as required to meet construction requirements.

E. After final cleaning of HVAC system, the system shall be flushed with 100% outdoor air for a two-week time period in accordance with ASHRAE Standard 62. After flush-out procedure, permanent final filters shall be installed in their respective systems.

F. After completion of the job, Contractor shall submit a letter indicating that the IAQ measures noted in this project have been met. The letter shall include specific dates for all cleaning, flushing and filter replacements.

3.7 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Supply	Galvanized Steel
Supply	Galvanized Steel
Return and Spill	Galvanized Steel
General Exhaust	Galvanized Steel
Outside Air Intake	Galvanized Steel

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Constant Volume Supply	3 inch wg (.75 kPa) regardless of velocity.
Variable Air Volume Supply (downstream of VAV boxes)	2 inch wg (.5 kPa) regardless of velocity.
Variable Air Volume Supply (upstream of VAV boxes)	6 inch wg (1.5 kPa)
Return and Relief, Spill	3 inch wg (.75 kPa)
General Exhaust	3 inch wg (.75 kPa)

Note: Minimum pressure class for systems other than those listed above shall be 2" w.g.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Duct access doors.
2. Volume control dampers.
3. Remote cable control damper.
4. Flexible duct connections.
5. Duct test holes.
6. Dial thermometers.
7. Static pressure gages.

B. Related Sections:

1. Section 23 09 00 - Instrumentation and Control for HVAC: Execution and Product requirements for connection and control of Combination Smoke and Fire Dampers for placement by this section.
2. Section 23 09 23 - Direct-Digital Control System for HVAC: Execution and Product requirements for connection and control of Combination Smoke and Fire Dampers for placement by this section.
3. Section 23 31 00 - HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.
4. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for connection of electrical Combination Smoke and Fire Dampers specified by this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

2. NFPA 92A - Recommended Practice for Smoke-Control Systems.

D. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.:

1. UL 555C - Standard for Safety for Ceiling Dampers.

1.3 SUBMITTALS

A. General Conditions - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.

C. Product Data: Submit data for shop fabricated assemblies and hardware used.

D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.

1. Flexible duct connections.

2. Volume control dampers.

3. Cable control dampers.

4. Duct access doors.

5. Duct test holes.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of access doors, test holes.

1.5 QUALITY ASSURANCE

A. Dampers tested, rated and labeled in accordance with the latest UL requirements.

B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

C. Perform Work in accordance with NYCBC and NYCMC.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years [documented] experience.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

B. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

C. Storage: Store materials in a dry area indoor, protected from damage.

D. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 COORDINATION

A. Coordinate Work where appropriate with building control Work.

1.11 EXTRA MATERIALS

A. Furnish two (2) of each size and type of fusible link.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR ALL ACCESSORIES

A. All accessories shall have a pressure rating equivalent to the duct system that they are installed in.

B. Material construction shall match system that accessories are installed in.

2.2 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Fabrication: Rigid and close fitting of galvanized steel or stainless steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch (25 mm) thick insulation with sheet metal cover, minimum 22 gage interior casing.

1. Less than 12 inches (300 mm) square, secure with sash locks.

2. Up to 18 inches (450 mm) Square: Furnish two hinges and two sash locks.

3. Up to 24 x 48 inches (600 x 1200 mm): Three hinges and two compression latches.

4. Larger Sizes: Furnish additional hinge.

5. Access doors located on the bottom of ducts shall have cam fasteners in lieu of hinges in order to avoid interference with ceiling channel supports.

6. Provide access doors upstream and downstream of reheat coils.

7. Provide access door for all dampers including volume dampers, fire dampers, smoke dampers, combination dampers and motorized dampers.

8. Access panels with sheet metal screw fasteners are not acceptable.

2.3 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch (200 x 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.

C. End Bearings: Except in round ductwork 12 inches (300 mm) and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg 500 Pa.

D. Quadrants:

1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.

2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches (750 mm) furnish regulator at both ends.

2.4 REMOTE CABLE CONTROL VOLUME DAMPERS

A. Provide cable control system for all volume dampers located above gpysum board and other inaccessible ceilings.

B. Bowden cable control kit shall provide all required hardware that shall be mounted onto all rectangular and round volume dampers and provide all interlocking gears and cabling for ceiling mounted control. Coverplate shall be 7/8" diameter cold rolled steel cover with zinc plating for painting by the Contractor. Provide five (5) 12" wrenches for operation.

2.5 FLEXIBLE DUCT CONNECTIONS

A. Provide a suitable flexible connection in both the intake and discharge sides of each fan and air handling unit, where they connect to ductwork.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL 181 Class 0 listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd (1.0 kg/sq m).

2. Net Fabric Width: Minimum 6 inches (150 mm) wide; maximum 10 inches (250 mm) wide.

3. Metal: 3 inch (75 mm) wide and 24 gage (0.6 mm thick) galvanized steel.

D. High Density Vinyl Sheet: Minimum 0.55 inch (14 mm) thick, 0.87 lbs. per sq ft (4.2 kg/sq m), 10 dB attenuation in 10 to 10,000 Hz range.

2.6 DUCT TEST HOLES

A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

B. Provide tappings in ducts for thermometers where specified. In addition, provide an airtight plugged tapping located as follows:

1. Upstream of each reheat coil.

2. Downstream of each reheat coil.

3. In each supply and return air duct at each floor.

2.7 DIAL THERMOMETERS

A. Thermometer: ASTM E1, stainless steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.

1. Size: 3 inch (76 mm).

2. Lens: Clear Lexan.

3. Accuracy: 1 percent.

4. Calibration: Degrees F.

2.8 STATIC PRESSURE GAGES

A. Dial Gages: 3-1/2 inch (89 mm) diameter dial in metal case, diaphragm actuated, black figures on white background, front calibration adjustment, 2 percent of full scale accuracy.

B. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch (6 mm) diameter tubing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify ducts and equipment installation is ready for accessories.

3.2 INSTALLATION

A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

B. Install dampers and accessories where indicated on Drawings.

C. Access Doors: Install access doors at the following locations and as indicated on Drawings:

1. Upstream of each reheat coil.

2. Before and after each duct mounted coil.

3. Before and after each duct mounted fan.

4. Before and after each automatic control damper.

5. Downstream of each VAV box.

D. Access Door Sizes: Install minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as indicated on Drawings. Install 4 x 4 inch (100 x 100 mm) for balancing dampers only. Review locations prior to fabrication.

E. Install temporary duct test holes where indicated on Drawings and required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

3.3 INSTALLATION - THERMOMETERS

A. Install thermometers in air duct systems on flanges.

B. Locate duct-mounted thermometers minimum 10 feet (3 m) downstream of mixing-dampers, coils, or other devices causing air turbulence.

C. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.

D. Provide instruments with scale ranges selected according to service with largest appropriate scale.

E. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

F. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.

G. Install thermometers in the following locations:

1. Each supply air zone.
2. Outside air.
3. Return air.
4. Mixed air.

3.4 STATIC PRESSURE AND FILTER GAGES:

A. Install filter and static pressure gages in the following locations:

1. Built up filter banks.
2. Unitary filter sections.
3. Supply fan discharge.

END OF SECTION

SECTION 23 34 00

HVAC FANS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal fans.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 07 00 - HVAC Insulation: Product requirements for power ventilators for placement by this section.
3. Section 23 09 00 - Instrumentation and Control for HVAC: Product requirements for control components to interface with fans.
4. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.
5. Section 23 31 00 - HVAC Ducts and Casings: Product requirements for hangers for placement by this section.
6. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
7. Section 26 05 03 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.

B. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.

2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

A. Product Data: Submit data on each fan accessory, RPM, and electrical characteristics.

B. Submit motor data in accordance with 230513.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for motor and drive replacement.

1.5 QUALITY ASSURANCE

A. Balance Quality: Conform to AMCA 204.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by Commissioner.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.8 DELIVERY, STORAGE AND HANDLING

A. Protect motors from weather and construction dust.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 EXTRA MATERIALS

A. Furnish two (2) sets of belts for each fan.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL FANS

A. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp (11.2 kW) and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 20 hp (15 kW) and over or fan controlled by VFD, matched belts (minimum 2 belts), and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide adjustable sheaves required for final air balance. Replace adjustable sheave with fixed sheaves after balancing as required.

3.2 DEMONSTRATION

A. Demonstrate fan operation.

3.3 PROTECTION OF FINISHED WORK

A. Do not operate fans until fans have been test run under observation.

END OF SECTION

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SECTION 26 05 00

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: This section includes general requirements for Electrical Work in accordance with the Contract Documents. The Contract Documents are as defined in the "AGREEMENT." The "GENERAL CONDITIONS" shall apply to all work under the Contract.

B. Related Documents:

1. All work shall be subject to the General Conditions and shall comply with applicable requirements of the Contract.

2. This Section governs all requirements as applicable to the Electrical work specified in other Sections of Division 26.

1.2 REFERENCE STANDARDS

A. Compliance with the following codes and standards shall be required as applicable:

1.	AEIC	Association of Edison Illuminating Companies
2.	ANSI	American National Standards Institute
3.	ASTM	American Society for Testing Materials
4.	BSA	Board of Standards and Appeals (BS&A, NYC)
5.	CBM	Certified Ballast Manufacturers
6.	DEMA	Diesel Engine Manufacturer's Association
7.	EPA	United Stated Environmental Protection Agency
8.	ETL	Intertek/Electric Testing Laboratories
9.	FM	Factory Mutual
10.	ICEA	Insulated Cable Engineers Association
11.	IEEE	Institute of Electrical and Electronics Engineers
12.	IES	Illumination Engineering Society of North America

13. MEA Materials and Equipment Acceptance (NYC)
14. NEC National Electrical Code
15. NEMA National Electrical Manufacturers Association
16. NETA Inter-National Electric Testing Association
17. NFPA National Fire Protection Association
18. NFC National Fire Codes (NFPA)
19. NYCBC New York City Building Code
20. NYCECC New York City Energy Conservation Code
21. NYCEC New York City Electrical Code
22. NYCFC New York City Fire Code
23. OSHA Occupational Safety and Health Administration
24. UL Underwriters' Laboratories, Inc.

B. Conform to materials and equipment rating standards, listings or classifications of the above organizations as well as ratings, listings or classifications accepted under local codes and laws.

1.3 DEFINITIONS

A. "Provide" means furnish and install, complete the specified material, equipment or other item and perform all required labor to make a finished installation.

B. "Furnish and install" has the same meaning as given above for "Provide."

C. "Commissioner" means the authorized representative of the City of New York.

D. Refer to General Conditions for other definitions.

1.4 CONTRACT DRAWINGS

A. The contract drawings indicate, in schematic and diagrammatic form, the extent and general arrangement of the various electrical systems. If the Contractor deems that any departures from these drawings are necessary, detailed drawings and descriptions of these departures and a statement of the reasons shall be submitted to the Commissioner for review and comment as soon as practicable. No departures from the arrangements

shown on the contract drawings shall be made without prior written approval of the Commissioner. Provide all devices, conduit, wire, misc. steel, etc., for a complete installation.

B. Conduits and other raceway systems shall be installed as shown or as noted on the contract drawings. Elevations and dimensions where indicated are a guide only and are subject to change with actual job conditions and clearances. Relocation resulting from interferences shall be made at no additional cost to the City of New York.

1.5 REVIEW OF CONTRACT DOCUMENTS AND SITE

A. With the submission of his Bid, Contractor shall give written notice to the City of New York of any materials or apparatus believed in-adequate or unsuitable, in violation of laws, ordinances, rules or regulations of Authorities Having Jurisdiction, and any necessary items of work omitted. In the absence of such written notice it is mutually agreed that the Contractor has included the cost of all required items in his Proposal for a complete project.

B. Contractor shall acknowledge that he has examined the Plans, Specifications and Site, and that from his own investigations he has satisfied himself as to the nature and location of the work; the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials; availability of labor, water, electric power, roads and uncertainties of weather; the conformation and condition of the ground; the character, quality and quantity of surface and subsurface materials to be encountered; the character of equipment and facilities needed preliminary to and during the execution of the work; all federal, state, county, township and municipal laws, ordinances and regulations particularly those relating to employment of labor, rates of wages, and construction methods; and all other matters which can in any way affect the work or the cost thereof under this Contract. Any failure by the Contractor to acquaint himself with the available information concerning these conditions will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work.

C. The City of New York assumes no responsibility for any understanding or representation made during or prior to the negotiation and execution of this Contract unless such understanding or representations are expressly stated in the Contract, and the Contract expressly provides that the responsibility, therefore, is assumed by the City Of New York.

1.6 SUBMITTALS

A. Procedure:

1. Prepare a schedule of specific submissions at the outset of the Project for the City of New York review and approval; make submissions listed below and in the other Sections of Division 26 of the Project Specifications.

a. If submissions listed in other Sections of Division 26 are more specific than those listed below, comply with the more specific requirements.

b. Failure of the Contractor to submit Shop Drawings in ample time for checking shall not entitle him to an extension of Contract time, and no claim for extension by reason of such default will be allowed.

c. Piecemeal submittals are unacceptable and will not be reviewed. No submittal shall be considered for review, the review of which is contingent upon acceptance of other features for which submittals have not been submitted.

d. Submittals from Vendor without Contractor's review and approval stamp will not be reviewed.

e. Submittals shall not be used by the Contractor as a means to secure approval of a substitution. Contractor must indicate all deviations, omissions and substitutions in his submittal; if there are none of these 3 exceptions, he shall then state on the submittal: "NO EXCEPTION TAKEN". Any submittal without stated exceptions, or without statement that no exception is taken, will not be reviewed and will be rejected and returned to Contractor for rectification.

f. All products of a similar nature (i.e., Panelboards, fuses, wiring devices, etc.) shall be provided by one manufacturer.

B. Shop Drawings:

1. Purpose:

a. The purpose of shop drawing is to identify the specific products that the Contractor is proposing to furnish and install on the project. Submittal of multiple manufacturers

for the same product will result in the entire submittal being returned without review.

2. Manufacturer's Drawings:

   a. Submit equipment listed in all applicable Sections - include material specifications, operating characteristics and finishes, specified agency listings or approvals.

   b. Cuts, brochures or other literature submitted for expeditious approval but incomplete or missing items of hardware or software (performance data) shall be re-submitted until all system or equipment components have been reviewed and approved. Any item not included in the original or first submission shall be considered outstanding work until such item of equipment or work has been submitted or installed in place exactly conforming to the intent of the contract documents.

   c. Contractor shall provide preliminary layout drawings of all major pieces of equipment (i.e., Switchgear, switchboards, transformers), confirming that the submitted product physically fits within the architectural enclosures. This drawing is required along with the manufacturer's product data.

3. Installation Drawings:

   a. Furnish coordinated drawings of equipment installation, including interconnecting conduit and supports. Minimum scale for these drawings shall be 1/4 inch equals one foot.

   b. Coordinate space requirements for mechanical, plumbing and other trades in the vicinity of work.

   c. Include connections, anchorages and fastenings for equipment and conduit.

   d. Make allowance for clearances for access to and maintenance of equipment.

   e. Do not install any conduits or equipment, in any area, prior to obtaining approval of its layout by means of submitting shop drawings.

f. Any missing items of equipment, material or labor, during initial submission of shop drawings, are to be completed and re-submitted for final approval. Shop drawing should not be used as a vehicle for obtaining variances, deviation or omission from the scope of Contract Documents. Approval of a submittal shall pertain to the portions that conform to the intent of the Contract Documents.

g. Submission of any missing, incomplete or otherwise deviant layout is subject to re-submission until all contract requirements have been properly included or shown on the same layout.

C. Required Samples:

1. Color samples, for prefinished items.

2. Natural finish metals, for quality of finish.

D. Reports:

1. Compliance with listings and approvals for equipment and for fire ratings.

2. Acceptance certificates from inspecting agencies.

3. Complete printed and illustrated operating instructions where required in report format.

4. Manufacturer's performance tests on operating equipment.

5. Performance reports for vibration isolation equipment.

6. Additional reports as noted in other sections.

E. Specific references to any article, device, product or material, fixture or item of equipment by name, make or catalog number shall be interpreted as establishing a basis of cost and a standard quality. All devices shall be of the make and type listed by Special Agencies, such as the Underwriters' Laboratories, and where required, approved by the Authority Having Jurisdiction.

F. Contractor shall be responsible for any deviations in equipment size or configuration and access requirement, from specified products.

1.7 COORDINATION

A. Dimensional layout plans of equipment rooms shall be made showing all bases, pads and inertia blocks required for electrical equipment. Include dimensions of bases, bolt layouts, details, etc.

B. Contractor shall furnish all necessary templates, patterns, etc., for installing work and for purpose of making adjoining work conform, furnish setting plans and shop details to other trades as required.

1.8 MEASUREMENTS

A. Contractor shall base all his measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. He shall verify all measurements at site; and check the correctness of same as related to the work.

1.9 LABOR AND MATERIALS

A. All materials and apparatus required for the work shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces.

B. Contractor shall remove all materials delivered, or work erected, which does not comply with Contract Drawings and Specifications, and replace with proper materials, or correct such work as directed, at no additional cost to the City of New York.

1.10 COVERING OF WORK

A. No electrical equipment, raceways or other work of any kind shall be covered up or hidden from view before it has been examined by the Commissioner. Any unsatisfactory or imperfect work or materials that may be discovered shall be removed and corrected immediately after being rejected and other work and materials shall be provided which shall be satisfactory to the Commissioner.

1.11 PROTECTION

A. Contractor shall protect the work and material of all trades from damage by his work or workmen, and shall replace all damaged material with new.

B. Contractor shall be responsible for work and equipment until his work is finally inspected, tested, and accepted; he shall protect his work against theft, injury or damage; and carefully store material and equipment received on site which is not immediately installed; close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

C. Contractor shall be responsible for the preservation of all public and private property, along and adjacent to the work, and shall use every precaution necessary to prevent damage or injury thereto. He shall use suitable precautions to prevent damage to pipes, conduits and other underground structures or utilities, and shall carefully protect from disturbance or damage all property marks until an authorized agent has witnessed or otherwise referenced their location, and shall not remove them until directed.

D. All mechanical and electrical equipment delivered to the site shall have appropriate wrapping to protect them from rain, flood, wind, construction debris and all types of water damage normally encountered at construction sites. Protection of equipment such as switchboard, transformers, panelboards, luminaires and similar equipment shall be the responsibility of the Contractor receiving such equipment at the jobsite.

1.12 CUTTING AND PATCHING

A. Provide all cutting and rough patching required for systems and equipment included in these specifications. All finish patching will be done under General Construction work.

B. Furnish and locate all sleeves and inserts required before the floors and walls are built; Contractor shall pay the cost of cutting and patching required for pipes where sleeves and inserts were not installed in time, or where incorrectly located. Provide all drilling required for the installation of hangers.

C. All holes cut through concrete slabs or arches shall be punched or drilled from the underside. No structural members shall be cut without the approval of the Commissioner and all such cutting shall be done in a manner directed by him.

D. Contractor shall not do any cutting that may impair strength of building construction. No holes, except for small screws, may be drilled in beams or other structural members without obtaining prior approval. All work

shall be done in a neat manner by mechanics skilled in their trades and as approved.

E. Provide sleeves and fire stopping at piping penetrations in floor, wall and roof.

1.13 ACOUSTICAL PERFORMANCE OF EQUIPMENT AND SYSTEMS

A. All work shall be designed to operate, and shall operate, under all conditions of load, without any objectionable sound or vibration. Sound or vibration noticeable outside of the room in which installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable and caused by failure to follow the Contract Documents or manufacturer's installation instructions shall be corrected in an approved manner by the Contractor at his expense.

1.14 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Instructions and Demonstration for the City of New York Personnel:

1. After all equipment is functioning properly, each system is to be automatically operated for ten (10) working shifts, and not to be adjusted during this period, 80 hours in heating and 80 hours in cooling seasons, scheduled at the convenience of the City of New York. Any adjustments will void the test and start the time period all over again.

2. The hours of operation are to include the City of New York designated personnel in each shift, for each season.

3. During this period, instruct the City of New York personnel in the use, operation and maintenance of all equipment of each system. Teaching will include a lecture-type instruction given in a non-machine room environment. During the lesson, normal operation of the system installed and operating will be explained, along with troubleshooting procedures. This will be followed by a field inspection and demonstration of equipment.

4. The above instruction is exclusive of that required of specified equipment manufacturers. If more stringent or longer instruction is indicated for specific equipment or systems, these shall supersede the above requirements.

B. Operating and Maintenance Data:

1. Provide four (4) complete sets of manufacturer's catalogues, instructions, maintenance and repair information and parts lists for operating equipment and devices.

   a. Include performance curves for fans and pumps, factory furnished wiring diagrams and control diagrams, and applicable flow diagrams.

   b. Submit seven sets of instructions for distribution.

2. Data for the equipment actually installed is to be submitted.

3. The data is to be carefully checked for accuracy by comparison with the installed equipment nameplates.

4. Provide a recommended list of spare parts for equipment and list of special, non-standard tools to service equipment.

5. Index and assemble the instructions in durable loose-leaf binders.

6. The completed binders are to be available at the time the equipment installation begins.

7. In addition, follow all requirements of the General Conditions and Addendum to General Conditions - Execution and Closeout Requirements: Closeout procedures.

1.15 RECORD DRAWINGS

A. Provide and maintain a currently up-to-date record set of reproducible prints showing all changes, additions or omissions made during construction. Contractor shall obtain, at his own expense, mylar copies of the Contract Drawings, for production of the Record Drawings.

B. Deliver four (4) sets of all as-built drawings and one (1) set of reproducibles of the record drawings to the City of New York before submitting requisition for final payment.

C. Shop Drawings shall be cross-referenced on the mylar copies for this requirement where applicable.

D. Submit AutoCAD compatible as-built drawing files.

1.16 WARRANTY

A. The following supplements the GENERAL CONDITIONS for Electrical Work:

1. Non-durable, expendable items such as lamps are not subject to replacement after the date of acceptance.

2. Warranty time limits for equipment exceeding those indicated in GENERAL CONDITIONS are specified in the applicable Sections of Division 26.

B. In addition, follow all requirements of the General Conditions and Addendum to General Conditions - Execution and Closeout Requirements: Closeout procedures.

PART 2 - PRODUCTS

2.1 IDENTIFICATION

A. Refer to Section 260553 for requirements.

2.2 ACCESS DOORS

A. General:

1. Steel, flush four-sided frame and door assembly, chemically cleaned after fabrication and painted with rust inhibitive primer.

2. Provide hardware and locking devices.

3. Provide access doors required for access to electrical work through finished wall construction and non-removable ceiling construction.

4. Deliver doors and location information to appropriate trade for installation.

5. Security Areas shall be provided with security access doors.

B. Furnish for installation by the appropriate trade, flush type access door or panel no smaller than 18" x 18" and no larger than 30" x 30" for all junction or pull boxes located in chases, walls, non-accessible hung ceilings or floors. Finish shall be prime coat, except floor panels which shall be polished brass or chrome plate. Doors and trim 14 gauge steel, frame 16 gauge steel, with flush concealed and standard flush locks, screwdriver operated cams, of Milcor manufacturer or approved equal.

1. All panels and their exact location subject to approval of the Commissioner.

2. Where space conditions prevent door swinging open, provide removable door on lift-up hinges. This will only be accepted on a case-by-case basis. This condition must be submitted to the City of New York for approval prior to installation.

3. Furnish a complete list locating all access doors required in finished walls, ceilings, partitions, shafts and other inaccessible locations.

2.3 PRIME PAINTING

A. All conduit, outlet boxes, pull boxes, splice boxes, supports and miscellaneous electrical within all Mechanical and Electrical equipment rooms shall be prime painted as specified herein.

B. All exposed conduits, boxes and supports, except factory finished equipment, shall be painted. All un-galvanized surfaces shall be painted with zinc chromate, or approved equal, and all galvanized surfaces shall be prime coated with a phosphate pretreatment coating, dry film thickness of 0.35 with a 0.50 mil. one coat Glid-Guard galvanized steel primer Y5229, or approved equal.

C. Upon completion of the prime coat of all electrical equipment specified above, all conduit, boxes and equipment shall be painted with finish coating, as specified under Division 9.

D. All damaged factory painted surfaces shall be repaired to match original surface. If, in opinion of the City of New York, such repairs are unsatisfactory, item in question shall be completely refinished or replaced with new.

2.4 CLEANING AND ADJUSTING

A. Notification:

1. Inform the City of New York and Commissioner's field representatives of all cleaning schedules one week prior to starting.

2. Notify the City of New York and the Commissioner again, 48-hours prior to each event. If neither attends the procedures, notify in writing, the specific task performed 24-hours after each event.

3. Damage to the building and equipment resulting from tests shall be repaired at no additional cost to the City of New York.

4. Tests claimed to have been performed without following above procedures shall be deemed as not performed.

B. Cleaning:

1. Clean out all debris and dirt from the interior of all switchboards, panelboards, transformers and switches. Blow out transformers with dry nitrogen; pressure shall not exceed 15 psi. Use Vacuum cleaner with bag and cartridge filters to remove dirt and debris from the interior of switchboards, panelboards and switches. After cleaning, the systems shall be tested by an independent organization, approved by New York Police Department prior to testing.

2. Clean all materials and equipment; leave in condition ready to operate and ready to receive succeeding finishes where required.

3. Clean the operating equipment and systems to be dust free inside and out.

C. Permanent Equipment Operating During Construction:

1. Use only in same service as the permanent applications, provided that written approval is granted by New York Police Department.

2. Expendable media, including lamps used for temporary operation and similar materials are to be replaced just prior to acceptance.

D. Retouch or repaint equipment furnished with factory finish as required to provide same appearance as new.

E. Tools:

1. Provide one set of specialized or non-standard maintenance tools and devices required for servicing the installed equipment.

PART 3 – EXECUTION

3.1 GENERAL

A. Temporary Protection:

1. Provide and maintain protection for the work whether completed or in progress.

2. Provide suitable coverings and enclosures.

B. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging and hoisting services necessary for erection, and/or delivery into the premises, of any equipment and apparatus furnished. Remove from the premises when no longer required.

C. Waterproofing:

1. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be as approved by the Commissioner before work is done. This Contractor shall provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

3.2 EQUIPMENT BASES, PLATFORMS AND SUPPORTS

A. Provide supporting platforms, steel supports, anchor bolts, inserts, etc., for all equipment and apparatus requiring access for service and maintenance.

B. Obtain prior approval for installation method of structural steel required to frame into building structural members for the proper support of equipment, conduit, etc. Welding will be permitted only when approved by the Commissioner or the Structural Engineer.

C. Submit shop drawings of supports for approval to the Commissioner before fabricating or constructing.

D. Provide leveling channels, anchor bolts, complete with nuts and washers, for all apparatus and equipment secured to concrete pads and further supply exact information and dimensions for the location of these leveling channels, anchor bolts, inserts, concrete bases and pads.

E. Where supports are on concrete construction, take care not to weaken concrete or penetrate waterproofing.

3.3 ACCESSIBILITY

A. The installation of electrical equipment, including panelboards, disconnect switches, motor starters, etc., shall be in accordance with the requirements of Article 110 or the New York City Electrical Code relative to work space around equipment. Equipment which is installed and does not have the working space required by the NYCEC, shall be relocated by the Contractor at no additional cost to the City of New York.

3.4 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof, for purposes other than testing even with the City of New York consent, shall not be construed to be an acceptance of the work on the part of the City of New York, nor shall it be construed to obligate the City of New York in any way to accept improper work or defective materials.

B. Use of permanent equipment for temporary services must be approved in writing by the City of New York.

3.5 CODES, RULES, PERMITS & FEES

A. The Contractor shall give all necessary notices, obtain all permits and filings including, but not limited to, New York City DEP, New York State DEC, New York City and State Building Code requirements, and pay all government sales taxes, fees, and other costs, in connection with his work. However, all utility connections, extensions, and tap fees for water, storm, sewer, gas, telephone, and electricity shall be paid directly to utility companies and/or agencies by the City of New York, unless otherwise indicated. The Contractor shall file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the City of New York Representative before request for acceptance and final payment for the work.

B. The complete design and construction shall conform to the requirements of the NYCBC, NYCEC, NYCFC and any other local or state code which may govern.

3.6 FINAL INSPECTION

A. Contractor shall arrange and schedule final inspection of work and shall notify the Commissioner in writing that the Contractor has thoroughly checked his work and, in the opinion of the Contractor, is ready for final inspection.

B. During the entire period schedule for these inspections, the Contractor and representatives of each manufacturer of equipment involved shall be present. All of these organizations shall have sufficient and competent personnel present so that adjustments can be made to all systems without delay.

3.7 ACCEPTANCE

A. The operation or the temporary use of the equipment and the mechanical and electrical installation, by the City of New York does not constitute an acceptance of the work. The final acceptance is to be made after the Contractor has adjusted his equipment, demonstrated that it fulfills the requirements of the Contract Documents, and has furnished all the required Certificates. Warranties and guaranties are effective after the acceptance.

END OF SECTION

SECTION 26 05 03

EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electrical connections to equipment.

B. Related Sections:

1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.

2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. General Conditions - Submittal Procedures: Submittal procedures.

B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

C. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.

B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.

C. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

A. Make electrical connections.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Install receptacle outlet to accommodate connection with attachment plug.

E. Install cord and cap for field-supplied attachment plug.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.4 ADJUSTING

A. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION

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SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Building Wire and Cable.
2. Wiring Connectors and Connections.

B. Related Sections:

1. Section 26 05 53 - Identification for Electrical Systems: Product requirements for wire identification.

1.2 REFERENCES

A. 2011 New York City Electrical Code

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:

1. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

D. Underwriter's Laboratories:

1. UL 83 – Thermoplastic-Insulated Wire and Cables.
2. UL 486A & 486B – Wire Connectors.
3. UL 486C – Splicing Wire Connectors.
4. UL 486D – Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
5. UL 510 – Standard for Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

6. UL 1063 – Standard for Machine-Tool Wires.

7. UL 1569 – Standard for Metal-Clad Cables.

8. UL 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:

1. Solid conductor for feeders and branch circuits 10 AWG and smaller.

2. Stranded conductors for control circuits.

3. Conductor not smaller than 12 AWG for power and lighting circuits.

4. Conductor not smaller than 14 AWG for control circuits.

5. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.

6. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

B. Wiring Methods: Provide the following wiring methods:

1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.

2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.

3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.

4. Wet or Damp Interior Locations: Use only building wire, Type USE-2 or XHHW insulation in raceway.

5. Exterior Locations: Use only building wire, Type USE-2 or XHHW insulation, in raceway.

6. Underground Locations: Use only building wire, Type USE-2 insulation in raceway.

1.4 DESIGN REQUIREMENTS

A. Conductor sizes are based on copper.

1.5 SUBMITTALS

A. Product Data:

1. Submit for building wire.
2. Submit for wiring connectors, including insulating materials.
3. Submit for conductor pulling lubricants.
4. Submit for tapes, including arc-proofing tapes.
5. Submit for cable ties.

B. Test Reports: Indicate procedures and values obtained.

C. Test Reports: Submit Calibration reports for torque drivers and torque wrenches used for electrical connections. Torque drivers and wrenches shall be lab calibrated prior to use on the project and every three months thereafter.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with 2011 New York City Electrical Code (NYCEC).

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

1.9 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION

A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

B. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 ft.

PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Subject to the requirements of the specifications, manufacturers offering products that may be suitable for use on this project include, but are not limited to, the following unless otherwise noted:

1. Colonial Wire and Cable Co.
2. Diamond Wire & Cable Co.
3. Essex Group Inc.
4. General Cable Co.
5. Southwire, Inc.
6. American Insulated Wire, Inc.
7. AFC Cable Systems.
8. Substitutions: General Conditions - Product Requirements.

2.2 BUILDING WIRE

A. Product Description: Single conductor insulated wire.

B. Conductor: Copper. Solid for No. 10 AWG and smaller; stranded (class B) for No. 8 AWG and larger.

C. Insulation Ratings: 600 volt; 90 degrees C.

D. Insulation Types:

1. Type THHN/THWN or XHHW insulation for feeders and branch circuits No. 6 AWG and larger.

2. Type THHN/THWN for feeders and branch circuits No. 8 AWG and smaller.

2.3 WIRING CONNECTORS

A. General:

1. Temperature rating of all connections and insulation materials shall not be less than that of the conductors and in no case shall be less than 75 degrees C.

2. Connectors with a copper rating shall be copper with tin-plating.

3. Pre-molded insulators shall be by the same manufacturer as the connector.

B. Compression Splices (copper conductors):

1. FCI Burndy: YS-L or YS series.

2. Thomas & Betts: 54800 or 54500 series.

3. Ilsco: CT or CTL series.

C. Compression Terminations (copper conductors):

1. FCI Burndy: YA, YAZ or YA-2N series.

2. Thomas & Betts: 54100, 54900 or 54800 series.

3. Ilsco: CRA, CRL or CRL2 series.

D. Compression Taps (copper conductors):

1. FCI Burndy: YH or YSH series.

2. Thomas & Betts: CHT series.

E. Lugs, Bolt Type:

1. FCI Burndy, Type KA-U.

2. ILSCO Type TA.

F. Heat Shrink Tubing:

1. FCI Burndy, Type HS-H-PF.

2. ILSCO Type Heavy Wall.

3. Tyco Electronics/Raychem Type WCSM.

4. Thomas & Betts Type HSFR.

G. Spring Wire Connectors:

1. Buchanan.

2. Ideal.

3. King Industries.

4. NSI Industries.

5. Thomas & Betts.

6. 3M.

H. Crimp Type Connectors (power and control wiring, No 10 AWG and smaller):

1. FCI Burndy.

2. Buchanan.

3. ILSCO.

4. Thomas & Betts.

2.4 CONDUCTOR PULLING LUBRICANTS

A. Description: Water soluble, polymer-based, non-toxic and non-sensitizing wire lubricant with volatile solids less than 6%. The lubricant shall have no flash point in gel state and shall leave a non-flammable residue when dry.

B. Appearance: Thick gel material, suitable for application with electrically operated pumping equipment.

C. Useful temperature range: 20 - 100 degrees F.

D. Lubricant shall be equal to the following:

1. American Polywater Corporation; Polywater Clear, Polywater J.

2. Ideal Industries; Clear Glide or AquaGel II.

2.5 TAPE

A. Insulation tape shall have a minimum of 350 volts per mil dielectric strength. Vinyl tape shall be equal to 3M Scotch No. 33. Tape for conductor phase identification shall be equal to 3M Scotch No. 35.

B. Rubber tape shall be self-fusing, non-corrosive, with minimum 350 volts per mil dielectric strength, and meeting the requirements of Federal Specification HH-I-553. Self-fusing rubber tape shall be equal to 3M No. 2155. This tape shall be limited to use on wiring of 600V or less.

2.6 CABLE TIES

A. Cable ties shall be self-locking type with a minimum width of .180 inches.

B. Ties for general purpose use shall be manufactured using 6/6 nylon. Color for general purpose ties shall be white.

C. Ties for use in air handling plenums or equipment shall be manufactured using Halar or an equal low smoke density material and shall meet UL 94V-O flammability requirement. Color for plenum rated ties shall be maroon.

D. Cable ties shall be as manufactured by the following:

1. FCI Burndy.

2. Panduit.

3. Thomas & Betts.

4. Approved Equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify interior of building has been protected from weather.

B. Verify mechanical work likely to damage wire and cable has been completed.

C. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Conduits and raceways shall be installed and completed prior to the installation of conductors.

B. Prior to installing cables in conduits, visually inspect conduits for damage. Thoroughly swab conduits and raceways before installing conductors. Verify that bushings are in place and properly secured to prevent damage to conductors.

3.3 APPLICATION

A. Wires and cables connected to equipment operating at 100 to 480 nominal volts shall be rated at 600 volts minimum unless otherwise indicated or specified. Where specified or where the nominal voltage is less than 50 volts, the wires or cables may be insulated for 300 volts, provided they are completely isolated from higher voltage systems by means of grounded metal barriers.

B. Wires and cables for secondary service, feeders and branch circuits shall be single conductor unless otherwise specified.

C. Wire and cable for miscellaneous system, such as Fire Alarm, is specified in the Technical Specification Sections for those systems.

3.4 EXISTING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.

B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.

C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.

D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.5 GENERAL WIRING REQUIREMENTS

A. Wiring shall be provided complete from point of service connection to all receptacles, lighting fixtures, power outlets, outlets for future extensions and other devices as shown. Slack wire shall be provided for all future connections. Unless otherwise specified, branch circuit conductors shall be No. 12 AWG or larger. In outlet boxes for future installations, ends of wires shall be taped and blank covers installed. Type of blank covers in finished areas are to be coordinated with Commissioner.

B. Cables shall not be bent either permanently or temporarily during installation to radii less than that recommended by the manufacturer.

C. Conductors not larger than No. 10 AWG located in branch circuit panelboards, signal cabinets and switchboard shall be bundled. Conductors larger than No. 10 AWG located in switchboard, distribution panels and pullboxes shall be bundled in individual circuits. Bundling and cabling shall be done with cable ties made of self-extinguishing nylon.

D. Where the length of a homerun, from panel to first circuit, exceeds 75 feet for a 120 volt circuit or 175 feet for a 277 volt and higher voltage circuit, the conductor size shall be minimum No. 10 AWG unless otherwise noted.

E. Where homerun circuit numbers are shown, such numbers shall be followed in connecting circuits to panelboards. Each branch circuit homerun containing two or more circuits with a common neutral shall be connected to the circuit breakers or switches in a three or four-wire branch circuit panelboard so that no two of the circuits will be fed from the same phase.

F. Conductors in distribution panels and switchboards which are bundled by circuit, shall be provided with arc-proofing as specified below.

3.6 INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Neatly train and secure wiring inside boxes, equipment, and panelboards.

C. Identify wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated. Wire shall be color coded as indicated in Item 3.7 below.

D. Special Techniques - Building Wire in Raceway:

1. Installation equipment shall be provided to prevent cutting and abrasion of conduits or conductors. Ropes used for pulling of feeders shall be made of polyethylene or other non-metallic material.

2. Pulling lines shall be attached to conductor cables by means of either woven basket grips or pulling eyes attached directly to the conductors. Rope hitches shall not be used.

3. Pull conductors into raceway at same time.

4. Install building wire 4 AWG and larger with pulling equipment.

5. Apply conductor pulling lubricant to conductors 4 AWG and larger as the conductors enter the raceway. For conductors 1/0 AWG and larger, the lubricant shall be mechanically applied with an electric pumping system that applies a uniform coating of lubricant to the conductors, as the conductors enter the conduit.

6. Install vertical conductor supports when installing conductors. Conductor supports shall be installed in accordance with the manufacturer's instructions.

7. Upon completion of conductor pulling, clean wire pulling lubricant from exposed portions of cables. If cables will not be immediately terminated, cut exposed copper conductor to insulation and seal conductor ends.

E. Special Techniques - Cable:

1. Protect exposed cable from damage.

2. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.

3. Use suitable cable fittings and connectors.

F. Special Techniques - Wiring Connections:

1. Perform all connection work in strict accordance with recommendations of manufacturers of the wire and connecting devices, unless otherwise noted.

2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

3. Clean conductor surfaces before installing lugs and connectors.

4. Apply anti-oxidation inhibitor compound containing copper to all stranded copper wire connections.

5. Install hydraulic compression connectors for copper conductor splices and taps, No. 6 AWG and larger.

6. Utilize hydraulic tools for compression connections in accordance with manufacturers' recommendations. Tools shall be non-removable until completion of the connection and shall leave an embossed mark to verify that proper die has been used.

7. Tools shall provide a hexagonal or circumferential crimp to the connectors. Indentation type tools are not acceptable.

8. Splices, taps and termination lugs shall be insulated with heavy wall heat shrink tubing. Tubing shall overlap the conductor insulation by a minimum of 2-inches. The tubing shall be applied using electric heat guns. Open flames or torches shall not be used.

9. Tighten all busbar and stud connections with Belleville washers, utilizing torque wrench or torque indicating washer designed for the purpose by the connector manufacturer.

10. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

11. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

G. Connector Application

1. Connectors applications listed shall be utilized when equipment is not provided with factory installed lugs.

2. Wire to busbar for wire sizes No. 1/0 AWG and smaller; one-hole hydraulic compression lug.

3. Wire to busbar for wire sizes No. 2/0 AWG and larger; two-hole hydraulic compression lug.

4. Wire to Stud, switch, or circuit breaker; one-hole mechanical lug.

5. Stranded wire, No. 8 AWG or larger splice, tap, or pigtail connection; hydraulic compression connector with heavy-wall heat shrink tubing or pre-molded thermoplastic insulator by connector manufacturer with two half-lapped layers of vinyl tape.

H. Install solid conductor for feeders and branch circuits 10 AWG and smaller.

3.7 WIRE COLOR

A. The covering of wires and cables shall have a distinctive color code for identification of individual conductors.

B. Secondary service, feeder and branch circuit conductors throughout the electrical system shall be color coded as follows:

Phase	120/240 Volts	208/120 Volts
A	Black	Black
B	Red	Red
C	-	Blue
Neutral	White	White
Ground	Green	Green
Isolated Ground	Green with tracer	Green with tracer
Neutral of Ground fault circuit	White with tracer	White with tracer

C. For conductor sizes No. 6 AWG and smaller, conductor insulation shall be color coded as indicated in the table above.

D. For conductor sizes No. 4 and larger, conductors shall be identified colored tape or heat shrink tubing at terminals, splices and boxes. Tape shall be applies half lapped, with a minimum length of 6 inches.

E. Neutral Conductors: When two or more neutrals are located in one conduit, individually identify each with a color tracer to match the phase conductor and proper circuit number.

3.8 ARC/FIREPROOFING

A. Where more than one set of cables, that are protected by more than one over-current protective device, are installed in a common equipment enclosure or box and any wire is larger than No. 4 AWG, then all sets of

conductors shall be covered with arcproof and fireproof tape. Where necessary to facilitate taping, boxes shall be oversized.

B. Tape shall be applied in a single layer, one half lapped, or as recommended by the manufacturer to conform to the above requirements. The tape shall be applied with the coated side next to the cable and shall be held in place with a random wrap of one half inch wide, pressure-sensitive fiberglass backed color plastic film tape. This tape shall not support combustion per ASTM.

3.9 MOTOR AND CONTROL WIRING

A. Provide all wiring to and between motors, starters, disconnect switches and other related electrical equipment except where such items are factory wired.

B. Provide control wiring at 120 volts or higher for control devices wired with branch circuits serving utilization equipment, unless otherwise specified in other Division of the Specifications.

C. For control devices operating at voltages lower than 120 volts nominal, refer to the respective Sections.

3.10 FIELD QUALITY CONTROL

A. In addition to any testing specified elsewhere in these Specifications, the Contractor shall perform basic testing of his work.

B. Contractor shall verify the continuity of all branch circuit wiring.

C. Contractor shall verify that branch circuits are properly terminated.

D. Measure the tightness of all conductor terminations using calibrated torque drivers or torque wrenches.

E. Verify the insulation integrity of all feeders using a 1,000 volt insulation resistance tester. Digital multi-meters shall not be used to verify insulation integrity.

F. Inspect and test in accordance with NETA ATS, except Section 4.

G. Perform inspections and tests listed in NETA ATS, Section 7.3.2.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wire.
2. Mechanical connectors.

B. Related Sections:

1. Section 26 05 19 – Low-voltage Electrical Power Conductors and Cables.
2. Section26 05 33 – Raceways and Boxes for Electrical Systems.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. 2011 New York City Electrical Code

1.3 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:

1. Existing Metal underground water pipe.
2. Metal building frame.

1.4 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms maximum.

1.5 SUBMITTALS

A. General Conditions - Submittal Procedures: Requirements for submittals.

1.6 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NYCEC, IEEE 142, and UL labeled.

B. Perform Work in accordance with the requirements of the 2011 New York City Electrical Code.

1.7 DELIVERY, STORAGE AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 WIRE

A. Material: copper. See Specification Section 26 05 19.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Modify existing grounding system to maintain continuity to accommodate renovations.

B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

A. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

B. Permanently ground entire light and power system in accordance with NYCEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform continuity testing in accordance with IEEE 142.

C. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conduit supports.
2. Formed steel channel.
3. Adhesive Anchor System.
4. Spring steel clips.
5. Sleeves.
6. Mechanical sleeve seals.
7. Firestopping relating to electrical work.
8. Firestopping accessories.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. 2011 New York City Electrical Code

C. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Firestops.

4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.

5. UL - Fire Resistance Directory.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

A. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

B. Adhesive Anchor System

1. Submit manufacturer's product data, load test data from on-site proof tests, and schedule of anchors, including the proposed use, for the project

C. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly. Details of each assembly shall be submitted, indicating the manufacturer's UL Listing Number for the system.

E. Design Data: Indicate load carrying capacity of trapeze hangers, hangers and supports.

F. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.

2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Engineering Judgments: For conditions not covered by UL listed designs, submit judgments by licensed professional engineer suitable for presentation to Authority Having Jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings as indicated on Architectural Drawings, but not less than 1-hour.

2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.

a. Floor Penetrations within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Non-combustible Penetrating Items: Non-combustible materials for penetrating items connecting maximum of three stories.

2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years' experience.

B. Installer: Company specializing in performing work of this section with minimum three (3) years' experience.

1.9 DELIVERY, STORAGE AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:

1. Allied Tube & Conduit Corp.

2. Electroline Manufacturing Company.

3. O-Z/Gedney Co.

4. Approved equal.

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

1. Size: Working load of rod support shall not exceed values below:

Rod Diameter	Maximum Load
3/8"	610 lbs.
1/2"	1130 lbs.
5/8"	1810 lbs.
3/4"	2710 lbs.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self-locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:

1. Allied Tube & Conduit Corp.

2. B-Line Systems.

3. Unistrut Corp.

4. Kindorf.

5. General Conditions: Alternate or Substitute Equipment.

B. Product Description: 12 gauge) thick steel. 1-1/2 inch by

2.3 ADHESIVE ANCHOR SYSTEM

A. Adhesive anchors shall be used to support all electrical equipment attached to terra cotta block walls or floor structures.

B. Adhesive anchor system shall be the product of one manufacturer, who shall be responsible for the entire anchor system.

C. Contractor shall retain the adhesive anchor manufacturer's representative to perform pull-out proof tests of the anchor system. Proof testing shall be performed prior to the actual installation of any equipment.

D. Adhesive anchor system shall be equal to Hilti HIT-HY 20 with HIT-S stainless steel tube screens and appropriate threaded rods or threaded inserts.

2.4 SLEEVES

A. Sleeves through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves through Walls, Footings, and Potentially Wet Floors: Schedule 40 Steel pipe; Schedule 40 stainless steel pipe for wet areas and below grade penetrations.

C. Sleeves for through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Schedule 40 steel pipe, minimum two trade sizes larger than penetrating pipe.

D. Sleeves for through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: For cables not in conduit, provide pre-fabricated fire rated sleeves including seals, UL listed.

E. Fire-stopping Insulation: Mineral wool, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.
3. Approved equal.
4. General Conditions: Alternate or Substitute Equipment.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products.
6. Specified Technology, Inc.
7. Approved equal.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.

6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.

7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:

1. Furnish UL listed products [or products tested by independent testing laboratory].

2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.

2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Obtain permission from Commissioner/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide precast inserts, expansion anchors, and preset inserts.

2. Steel Structural Elements: Provide beam clamps or welded fasteners. Welded fasteners shall be reviewed by the Structural Engineer prior to installation.

3. Concrete Surfaces: Provide expansion anchors.

4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.

5. Solid Masonry Walls: Provide expansion anchors.

6. Sheet Metal: Provide sheet metal screws.

7. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.

2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

C. Install conduit and raceway support and spacing in accordance with 2011 New York City Electric Code, except spacing of supports for EMT shall not exceed 8'-0" on center.

D. Do not fasten supports to pipes, ducts, mechanical equipment, roof deck, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.

2. Install surface mounted cabinets and panelboards with minimum of four anchors.

3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.

4. Support vertical conduit at every floor.

3.4 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and/or roof as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.

c. Pack void with backing material.

d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where cable tray, bus, cable bus duct, conduit, wireway, or trough penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

E. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.

c. Install type of firestopping material recommended by manufacturer.

2. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

4. Interior partitions: Seal all pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction.

E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with mineral wool insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install escutcheons at finished surfaces.

3.6 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule. Provide Controlled Inspections as required by the NYCBC.

3.7 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.8 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Conduit and tubing
2. Surface raceways
3. Wireways
4. Outlet boxes
5. Pull and junction boxes
6. Handholes.

B. Related Sections:

1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
3. Section 26 05 53 - Identification for Electrical Systems.
4. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. 2011 New York City Electrical Code

B. American National Standards Institute:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

C. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports.

D. Underwriters Laboratories, Inc.

1. UL 1 – Standard for Flexible Metal Conduit.

2. UL 6 – Standard for Electrical Rigid Metal Conduit.

3. UL 6A – Standard for Electrical Rigid Metal Conduit – Aluminum and Stainless Steel.

4. UL 360 – Standard for Liquid-Tight Flexible Steel Conduit.

5. UL 467 – Standard for Grounding and Bonding Equipment.

6. UL 514B – Standard for Fittings for Cable and Conduit.

7. UL 797 – Standard for Electrical Metallic Tubing – Steel.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Outdoor Locations, Above Grade: Provide rigid steel conduit. Provide cast iron alloy metal outlet, pull, and junction boxes.

C. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.

D. Concealed Dry Locations: Provide rigid steel. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

E. Exposed Dry Locations: Provide rigid steel conduit where less than 10 feet above the finished floor and in all mechanical rooms. Provide sheet-metal boxes. Provide hinged enclosure for large pull boxes.

F. Within Metal Stud walls: Provide EMT conduit with steel compression fittings, and sheet steel outlet boxes.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

B. All conduits shall be concealed within wall construction unless otherwise indicated on the drawings.

1.5 SUBMITTALS

A. Product Data: Submit for the following:

1. Raceway fittings.

2. Conduit bodies.

3. Surface raceway.

4. Wireway.

5. Pull and junction boxes.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents:

1. Record actual routing of conduits larger than 2 inch.

2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

B. Protect PVC conduit from sunlight.

1.8 COORDINATION

A. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.

B. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:

1. Conduit – Metallic:

a. Allied Tube and Conduit Corporation.

b. Triangle Wire and Cable Co.

c. Republic Conduit.

d. Wheatland Conduit.

e. Or Approved Equal.

2. Conduit – Metallic Fittings:

a. Bridgeport.

b. Cooper/Crouse-Hinds.

c. Thomas & Betts Corporation.

d. O-Z/Gedney.

e. Appleton Electrical Products.

f. Or Approved Equal.

B. Rigid Steel Conduit: ANSI C80.1.

C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 FLEXIBLE METAL CONDUIT

A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:

1. AFC Cable Systems.
2. Alflex Corporation.
3. Electri-Flex Company.
4. Or Approved Equal.

B. Product Description: Interlocked steel construction.

C. Fittings: NEMA FB 1; steel or cast iron with zinc coating. Die-cast zinc fittings are not permitted.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:

1. AFC Cable Systems.
2. Alflex Corporation.
3. Electri-Flex Company.
4. Or Approved Equal.

B. Product Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1; steel or cast iron with zinc coating. Die-cast zinc fittings are not permitted.

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:

1. Allied Tube and Conduit Corporation.
2. Triangle Wire and Cable Co.

3. Republic Conduit.

4. RobRoy Conduit.

5. Wheatland Conduit.

6. Or Approved Equal.

B. Product Description: ANSI C80.3; galvanized steel tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression type. Die-cast zinc fittings are not permitted.

2.5 SURFACE METAL RACEWAY

A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:

1. Hubbell, Inc.

2. Panduit Corporation.

3. The Wiremold Company.

4. Or Approved Equal.

B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway. Raceway shall be provided with and internal metal divided to separate low-voltage cabling from line voltage conductors.

C. Size: 4.75 x 1.75 inch.

D. Finish: Gray enamel.

E. Fittings, closures and device mountings: Furnish manufacturer's standard accessories; match finish on raceway.

2.6 WIREWAY

A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:

1. Hammond Manufacturing.

2. Hoffman.

3. Schneider Electric/Square D.

4. The Wiremold Company.

5. Or Approved Equal.

B. Product Description: General purpose type wireway.

C. Knockouts: None.

D. Size: as indicated on the drawings, but not less than 6 x 6 inch; length as indicated on Drawings.

E. Cover: Screw cover.

F. Connector: Slip-in.

G. Fittings: Lay-in type with removable side; captive screws.

H. Finish: Rust inhibiting primer coating with gray enamel finish.

2.7 OUTLET BOXES

A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:

1. Hubbell/Raco.

2. Thomas & Betts/Steel City.

3. Or Approved Equal.

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.

2. Provide Extension rings as required to accommodate wall thickness.

C. Cast Boxes: NEMA FB 1, Type FD, cast iron alloy with threaded hubs, zinc coated. In wet or damp locations, furnish gasketed cover, UL Listed as "in-use" for receptacles.

D. Wall Plates for Finished Areas: As specified in Section 26 27 26.

E. Wall Plates for Unfinished Areas: As specified on Section 26 27 26.

2.8 PULL AND JUNCTION BOXES

A. Subject to compliance with the requirements of the Specification, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:

1. Hammond Manufacturing.

2. Hoffman.

3. Or Approved Equal.

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.

2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 INSTALLATION

A. Install Work in accordance with the 2011 New York City Electrical Code.

B. Ground and bond raceway and boxes in accordance with Section 26 05 26.

C. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.

D. Identify raceway and boxes in accordance with Section 26 05 53.

E. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.3 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Unless otherwise indicated, all raceway shall be concealed in walls or above ceilings in all finished spaces.

C. Arrange raceway supports to prevent misalignment during wiring installation.

D. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

E. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.

F. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

G. Do not attach raceway to ceiling support wires or other piping systems.

H. Construct wireway supports from steel channel specified in Section 26 05 29.

I. Route exposed raceway parallel and perpendicular to walls.

J. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

K. Route conduit in and under slab from point-to-point.

L. Conduit in Slab Above Grade: Not Permitted.

M. Maintain clearance between raceway and piping for maintenance purposes.

N. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

O. Cut conduit square using saw or pipe cutter; de-burr cut ends.

P. Bring conduit to shoulder of fittings; fasten securely.

Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Provide hydraulic one-shot bender to fabricate bends in metal conduit larger than 2 inch size.

S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

T. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.

U. Install suitable 250 pound test polypropylene pull line in each empty raceway except sleeves and nipples.

V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

X. Close ends and unused openings in wireway.

3.4 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings or specified in section for outlet device.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

G. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

H. Install stamped steel bridges to fasten flush mounting outlet box between studs.

I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

J. Install adjustable steel channel fasteners for hung ceiling outlet box.

K. Do not fasten boxes to ceiling support wires or other piping systems.

L. Support boxes independently of conduit.

M. Install gang box where more than one device is mounted together. Do not use sectional box.

N. Install gang box with plaster ring for single device outlets.

3.5 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods that are approved by all applicable codes.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket

C. Locate outlet boxes to allow luminaires positioned as indicated on Architectural reflected ceiling plan.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.6 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused openings in boxes.

3.7 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Stencils.
6. Lockout Devices.

1.2 SUBMITTALS

A. Product Data:

1. Submit manufacturer's catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location and function.

B. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures and installation.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with 2011 New York City Electrical Code.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years' experience.

B. Installer: Company specializing in performing Work of this section with minimum three (3) years' experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Accept identification products on site in original containers. Inspect for damage.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Install labels only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Seton.
2. Brady.
3. Or Approved Equal.

B. Product Description: Laminated three-layer plastic with engraved black letters on white background color. Yellow letters on a red background for emergency equipment. Black letters on a yellow background for standby power.

C. Letter Size: See Nameplate Type Schedule below.

D. Minimum nameplate thickness: 1/8.

2.2 LABELS

A. Manufacturers:

1. Seton.
2. Brady.
3. Approved Equal

B. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

2.3 WIRE MARKERS

A. Manufacturers:

1. Seton.

2. Brady.

3. Approved Equal

B. Description: Cloth tape, split sleeve type wire markers.

C. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.

2. Control Circuits: Control wire number as indicated on shop drawings.

D. Legend:

1. Medium Voltage System: High Voltage.

2. 208 Volt System: 208/120 Volts.

2.4 PLASTIC NAMEPLATES

A. Laminated plastic nameplates shall be 3/4 inch by 2 inches or larger in dimension, fastened with counter-sunk, oval head, chrome plated machine screws. Lettering height shall be as noted, white, engraved and shall designate the equipment served or the specific equipment designation as shown on the contract drawings. Smaller nameplate lettering may be used where adequate nameplate mounting space is not available but in no case shall the lettering be smaller than 1/8 inch.

B. Background color shall be red for emergency life safety system panelboards, black for others. Refer to general Conditions are additional color requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with General Conditions for stencil painting.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:

1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners.
3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
4. Secure nameplate to equipment front using screws.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.

3.3 NAMEPLATE SCHEDULE

A. Nameplates shall be provided for the following electrical equipment:

	ITEM	NAMEPLATE TYPE
1.	Distribution panelboards	A
2.	Main and branch over current devices in distribution panelboards	B
3.	Lighting, receptacle and power panelboards	A
4.	Safety switches	B
5.	Pullboxes and cable tap boxes	F
6.	Pushbuttons, pilot lights, etc. for motor controls	H
7.	Control panels	G

B. Nameplate Type Schedule:

'A'	Line 1:	Equipment Designation (1" high letters)
	Line 2:	Voltage, phase, No. wires (1/2" high letters)
	Line 3:	Incoming feeder designation (1/2" high letters)
'B'	Line 1:	Load description (1/4" high letters)
	Line 2:	Breaker trip or fuse rating (1/4" high letters)
'C'	Line 1:	Transformer KVA rating (1" high letters)
	Line 2:	Designation of panel served (1/2" high letters)
	Line 3:	Incoming feeder designation (1/2" high letters)
'D'	Line 1:	ATS designation (1" high letters)
	Line 2:	Designation of panel served (1/2" high letters)
	Line 3:	Incoming normal feeder/incoming emergency feeder designation (1/2" high letters)
'E'	Line 1:	"Spare Fuse Cabinet" (1" high letters)
'F'	Line 1:	Feeder designations (1/4" high letters)
'G'	Line 1:	Cabinet Designation (1" high letters)
'H'	Line 1:	Description of operation and equipment controlled (1/2" high letters)

3.4 LABEL INSTALLATION

A. Install label parallel to equipment lines.

B. Install label for identification of individual control device stations.

C. Install labels for permanent adhesion and seal with clear lacquer.

3.5 WIRE MARKER INSTALLATION

A. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

B. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.

C. Install labels at data outlets identifying patch panel and port designation.

END OF SECTION

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SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceiling Mounted Occupancy Sensors.
2. Wireless Ceiling Mounted Occupancy Sensors.
3. Wall Mounted Vacancy Sensors.
4. Wall Mounted Occupancy Sensors.
5. Wall Mounted Dimming controller.

B. Related Sections:

1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
3. Section 26 05 53 - Identification for Electrical Systems.
4. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.
2. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
3. NEMA ICS 6 - Industrial Control and Systems: Enclosures.

1.3 SYSTEM DESCRIPTION

A. Where indicated on drawings, provide low voltage wireless lighting control vacancy sensor.

1.4 SUBMITTALS

A. General Conditions - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.

1. One Line Diagram: Indicating system configuration indicating panels, number and type of switches or devices.

2. Include typical wiring diagrams for each component.

C. Product Data: Submit manufacturer's standard product data for each system component.

D. Manufacturer's Installation Instructions: Submit for each system component.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record the following information:

1. Actual locations of components and record circuiting and switching arrangements.

2. Wiring diagrams reflecting field installed conditions with identified and numbered, system components and devices.

B. Operation and Maintenance Data:

1. Submit replacement parts numbers.

2. Submit manufacturer's published installation instructions and operating instructions.

3. Recommended renewal parts list.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the requirements of the 2011 New York City Electrical Code.

B. Maintain one (1) copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years' experience.

1.8 PRE-INSTALLATION MEETING

A. Convene minimum one (1) week prior to commencing work of this section.

1.9 DELIVERY, STORAGE AND HANDLING

A. Accept components on site in manufacturer's packaging. Inspect for damage.

B. Protect components by storing in manufacturer's containers indoor protected from weather.

1.10 WARRANTY

A. Furnish five-year manufacturer warranty for components.

1.11 EXTRA MATERIALS

A. Furnish two (2) of each sensor type.

PART 2 - PRODUCTS

2.1 CEILING MOUNTED OCCUPANCY SENSOR

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:

1. Lutron.

2. Watt Stopper.

3. Hubbell.

4. Lightolier - Philips.

B. Dual technology, ceiling mounted sensor utilizing both ultrasonic and infrared technology to turn lights on. Detection verification of both technologies is required to turn the lights on. Upon verification, either technology shall hold the lights on.

C. Sensor shall be ceiling mounted an unobtrusive appearance and 360 degrees of coverage.

D. Separate sensitivity and time delay adjustments with LED indication of sensed movement. User adjustable time-delay: 5 to 30 minutes.

E. Sensor shall operate on 24VDC furnished from a self-contained power supply and relay module. The module shall have a 1/2" snap-in nipple for 1/2" knock-outs and mounting on the outside of an enclosure or junction box.

F. Power pack module shall have dry contacts capable of switching 20-amp ballast and incandescent loads at 120 volts. Power pack shall accept 120 Volt AC, 60 Hz input.

G. Power pack shall be UL 2043 plenum rated and shall have low-voltage, Teflon coated leads rated for 300 volts.

H. Power pack and sensors shall be products of the same manufacturer and shall have a five-year warranty.

2.2 WIRELESS CEILING-MOUNTED OCCUPANCY SENSOR

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:

1. Lutron.

2. Watt Stopper.

3. Hubbell.

4. Lightolier - Philips.

B. Dual technology, ceiling mounted sensor utilizing both ultrasonic and infrared technology to turn lights on. Detection verification of both technologies is required to turn the lights on. Upon verification, either technology shall hold the lights on. Sensor to be interfaced with wireless wall switch replacing standard controls.

C. Sensor shall be ceiling mounted an unobtrusive appearance and 360 degrees of coverage.

D. Separate sensitivity and time delay adjustments with LED indication of sensed movement. User adjustable time-delay: 5 to 30 minutes.

E. Sensor shall operate on battery

2.3 WALL MOUNTED VACANCY SENSOR

A. Manufacturers:

1. Lutron.
2. Watt Stopper.
3. Hubbell.
4. Lightolier - Philips.

B. Description: Wall mounted infrared vacancy sensor for control of lighting. Unit shall be manual on, automatic off.

C. Ratings:

1. Voltage: 120 volts, AC.
2. Load: 0 to 600 watts, ballast, incandescent, LED, compact fluorescent, or low-voltage.

D. Housing: Thermoplastic with a polycarbonate sensor lens and three wire leads. Provide with a decorator type cover plate.

E. On-Off control: Air gap relay contact.

F. Mounting: Wall mounted (replaces standard switch).

G. Time delay: Adjustable, 30 seconds to 30 minutes. Set at 15 minutes.

H. Sensor technology: Passive infrared.

2.4 WALL MOUNTED OCCUPANCY SENSOR

A. Manufacturers:

1. Lutron.
2. Watt Stopper.
3. Hubbell.
4. Lightolier - Philips.

B. Description: Wall mounted infrared occupancy sensor for control of lighting. Unit shall be automatic on, automatic off.

C. Ratings:

1. Voltage: 120 volts, AC.

2. Load: 0 to 600 watts, ballast, incandescent, LED, compact fluorescent, or low-voltage.

D. Housing: Thermoplastic with a polycarbonate sensor lens and three wire leads. Provide with a decorator type cover plate.

E. On-Off control: Air gap relay contact.

F. Mounting: Wall mounted (replaces standard switch).

G. Time delay: Adjustable, 30 seconds to 30 minutes. Set at 15 minutes.

H. Sensor technology: Passive infrared.

2.5 WALL MOUNTED DIMMING CONTROLLER

A. Manufacturers:

1. Lutron.

2. Watt Stopper.

3. Hubbell.

4. Lightolier - Philips.

B. Description: Wall mounted dimming controller to control lighting level in room. Shall be compatible with Compact Fluorescent Lamps.

C. Ratings:

1. Voltage: 120 volts, AC.

D. Housing: Thermoplastic with a polycarbonate sensor lens and three wire leads. Provide with a decorator type cover plate.

E. Mounting: Wall mounted (replaces standard switch).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount sensors as indicated on Drawings.

B. Install wiring in accordance with Section 26 05 19.

C. Use only properly color coded wire and cable. Install wire sizes as indicated on Drawings. Install line voltage wire in conduit in accordance with Section 26 05 33. Install low-voltage cable above suspended ceilings, supported from the building structure. Cable shall not be supported by the ceiling grid or tiles.

3.2 MANUFACTURER'S FIELD SERVICES

A. General Conditions - Quality Requirements: Requirements for manufacturer's field services.

B. Furnish services for minimum of one day for check, test, and start-up. Perform the following services:

1. Check installation of vacancy and occupancy sensors.

2. Adjust sensitivity and timing of all sensors.

3. Repair or replace defective components.

3.3 ADJUSTING

A. Test each system component after installation to verify proper operation.

B. Test switches after installation to confirm proper operation.

C. Confirm correct loads are recorded on directory card in each panel.

3.4 DEMONSTRATION

A. Demonstrate operation of the following system components:

1. Operation of each type of occupancy sensors.

2. Connection and maintenance of power packs.

B. Furnish 4 hours to instruct the City of New York personnel in operation and maintenance of system. Schedule training with the City of New York, provide at least 7 days' notice to City of New York representative of training date.

END OF SECTION

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SECTION 26 09 43

NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Networked lighting control system and components:

a. Lighting Management Hub

b. Lighting Management System Software

c. Wired Sensors

d. Accessories

B. Related Sections:

1. Section 23 09 23 - Direct-Digital Control System for HVAC: Execution requirements for interfacing direct digital control systems with lighting control system specified in this section.

2. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

3. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Product requirements for raceway and boxes for placement by this section.

4. Section 26 05 53 - Identification for Electrical Systems: Product requirements for electrical identification items for placement by this section.

5. Section 26 27 26 - Wiring Devices: Product requirements for wiring devices for placement by this section.

1.2 REFERENCES

A. Federal Communications Commission:

1. Standard for Radio Frequency Equipment.

B. Government Electronics and Information Technology Association:

1. EIA 709.1 - Control Network Protocol Specification.

C. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. National Fire Protection Association:

1. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

E. Underwriters Laboratories Inc.:

1. UL 50 - Enclosures for Electrical Equipment.

2. UL 67 - Panelboards.

3. UL 508 - Industrial Control Equipment.

4. UL 916 - Energy Management Equipment.

F. 2011 New York City Electrical Code

1.3 SYSTEM DESCRIPTION

A. Provide networked lighting control system consisting of components manufactured by single source.

B. Provide networked lighting control system consisting of:

1. Multiple relay panels linked over network wiring using BacNet and connecting to the Building Management System.

2. Relay panels and programmable switches connected together by networked wiring system extending from panel locations with single communications bus to allow switches to communicate with panels.

3. Each relay panel shall be connected to single time clock mounted in interior of relay panel.

C. Networked lighting control system performs lighting control in the following building areas:

1. Language Literature

2. Children Ready Area
3. Social Science/Science Industry
4. Art and Music Division
5. Grand Lobby

1.4 SUBMITTALS

A. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.

1. One Line Diagram: Indicating system configuration indicating panels, number and type of switches, data line, and network time clock.
2. Drawings for each panel showing hardware configuration and numbering.
3. Panel wiring schedules.
4. Include typical wiring diagrams for each component.

B. Product Data: Submit manufacturer's standard product data for each system component.

C. Manufacturer's Installation Instructions: Submit for each system component.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements. Submit in writing system has been installed, adjusted, and tested in accordance with manufacturer's recommendations.

E. Manufacturer's Field Reports: Submit system startup report indicating date of completion and acknowledgment of programming completion. Indicate acceptance of component and equipment installation, interconnecting wiring, and start-up of system software.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record the following information:

1. Wiring diagrams reflecting field installed conditions with identified and numbered, system components and devices.
2. Drawings for each panel showing hardware configuration and numbering.

B. Operation and Maintenance Data:

1. Submit manufacturer's published installation instructions, operating instructions, programming instructions, and operator's guide.

2. System user's guide and programmer's guide.

3. Instruction books and manufacturer's printed materials.

4. Recommended renewal parts list.

1.6 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

B. Comply with 2011 New York City Electric Code as applicable to electrical wiring work.

C. Comply with NEMA 250 for type of electrical equipment enclosures.

D. Provide panelboards with UL listing in accordance with UL 50, UL 67, and UL 916.

E. Provide equipment complying with FCC emissions' standards in part 15 subpart J for Class A application.

F. Perform Work in accordance with 2008 New York City Building Code.

G. Maintain one (1) copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing lighting control system listed in this section, with minimum three (3) years experience.

B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience approved by Commissioner.

1.8 PRE-INSTALLATION MEETINGS

A. Convene minimum one (1) week prior to commencing work of this section.

1.9 DELIVERY, STORAGE AND HANDLING

A. Accept system components on site in manufacturer's packaging. Inspect for damage.

B. Protect components by storing in manufacturer's containers indoor protected from weather.

1.10 WARRANTY

A. Furnish 5-year manufacturer's warranty for each system component.

1.11 MAINTENANCE GUARANTEE

A. Furnish service and maintenance of system for one (1) year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including checkout and adjustments.

B. Furnish 24-hour emergency service during working hours on breakdowns and malfunctions for this maintenance period.

C. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, with maximum 4-hour response time.

D. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

E. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of DDC.

1.12 EXTRA MATERIALS

A. Furnish 20 percent of total number of relays.

PART 2 - PRODUCTS

2.1 NETWORKED LIGHTING CONTROL SYSTEM

A. Manufacturers:

1. Lutron Electronics Company

2. Greengage/Cooper Lighting

3. GE Lighting or approved equal.

B. Furnish materials in accordance with 2008 New York City Building Code.

C. Product Description: Networked lighting control system consisting of the following components: relay panels, network wiring, programmable network wired switches, programmable clock, software, and capability of integration into building automation system.

2.2 RELAY PANELS

A. UL listed, NEMA 250 Type 1 enclosure sized to accept up to 32 or 48 relays as indicated in the lighting control schedule shown on the drawings.

B. Power Supply: Transformer assembly with two 40 VA transformers with separate secondaries. Transformers include internal overcurrent protection with automatic reset and metal oxide varistor protection against power line spikes.

C. Voltage: 120 VAC, 60 Hertz, plus or minus 10 percent.

D. Mounting: Surface.

E. Cover: Hinged, locking configuration with wiring schedule directory card.

F. Interior: Bracket and intelligence board backplane with factory mounted and tested relays.

G. Furnish with integral DIN rail mounting bar to allow for installation of system components. Furnish terminals to accept network wiring for connection of switches to system, or to allow network wiring to be run between multiple panels for network communications between panels.

H. Furnish with individual on-off switches for both panel and network wiring power.

I. Furnish eight (8) channels in each interior regardless of size, each with associated pushbutton to toggle channel on-off, and terminal block for separate dry contact input. Each relay in panel capable of being assigned to each channel, with overlapping allowed. Furnish each channel pushbutton with LED state indication.

J. Furnish each channel pushbutton with LED status indication.

K. Relays:

1. Type: Momentary-pulsed mechanically latching contactors rated at 20 amps, 120 to 277 VAC attached to interior by plug-in type connector.

2. Locate next to each relay individual override button and LED to indicate status - relay on, relay off or relay failure.

3. Furnish screw terminations for each wiring connection.

4. Furnish each channel button's dry control contact input terminal with capability of accepting 2 or 3 wire, maintained or momentary inputs and 2 wire toggling input.

5. Furnish each channel with isolated contact for use with status feedback or pilot light control.

6. Relay Panel records channel wiring assignments and current status of each relay, in non-volatile memory to prevent data loss on power failure.

7. Furnish LED status indication of power supply status. Furnish access to 24 VAC and 24 V rectified power for accessory devices within panel.

8. Interior uses relays with pilot contact to provide individual relay feedback to other systems. Locate terminal blocks next to each relay to allow standard low voltage switching devices to control relay state. Devices can be either 2 or 3 wire, maintained or momentary inputs. Devices also accept 2 wire toggling input.

9. System to comply with EIA 709.1 lighting controller profile and furnish capability for network connecting to EIA 709.1 compliant building automation system components without use of dry contacts, gateways, protocol converters or additional devices.

2.3 NETWORK WIRING

A. Material: 18/4 twisted conductor with shield meeting Class 2 requirements. Data line can be run in loop, serial, or star configuration. Minimum 1 turn for each 3 inches; 50 picofarads/foot maximum.

B. Maximum length: 1,500 feet.

C. Maximum number of devices: 127.

2.4 LOW-VOLTAGE WALL STATION

A. Product: Key Switch.

B. Electronics:

1. Use RS485 wiring for low voltage communication.

C. Functionality:

1. Upon button press, LEDs to immediately illuminate.

2. LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or the LEDs turn off if the button press was not processed.

3. Allow for easy reprogramming without replacing unit.

4. Replacement of units does not require reprogramming.

D. Color:

1. Match existing wall color.

2. Color variation in same product family: Maximum $\Delta E=1$, CIE L*a*b color units.

3. Visible parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

E. Provide faceplates with concealed mounting hardware.

F. Engrave wall stations with appropriate button, zone, and scene engraving descriptions furnished prior to fabrication.

G. Silk-screened borders, logos, and graduations to use graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.

2.5 PROGRAMMABLE CLOCK

A. Provide integral time clock for each lighting control panel.

B. From each plug-in point on network wiring, time clock can be used to:

1. Schedule each 8 channel groups in relay panel network.

2. Program network wired switches.

C. Includes user selectable functions to handle standard lighting control functions for each channel independently. Selectable functions include:

1. Scheduled on and scheduled off.

2. Manual on and scheduled off.

3. Astronomical on and astronomical off with optional offset.

4. Astronomical on and scheduled off with optional offset.

D. Each channel capable of being assigned the following:

1. Time delay from 1 to 256 minutes.

2. Automatic blinking of lights before turning off to allow occupants opportunity to enter override. Time interval configurable.

E. Features:

1. Furnish clock with display and user interface.

2. Capable of being adjusted for leap year, daylight savings dates, and holidays.

2.6 SOFTWARE

A. Furnish plug-in capability for use in system commissioning, programming, monitoring, and control. Software capable of functioning with EIA 709.1 compliant network tool.

B. After programming of system parameters is completed, system allows each user-definable feature such as schedules, relay groups, switch assignments to be field modified without need for configuration software or system integration expertise.

2.7 BAS INTEGRATION

A. In addition to hardwired channel inputs, furnish system with capability for integration into building automation system without use of dry contact,

gateways or protocol converters. Integration accomplished via network connections of EIA 709.1 compliant devices.

B. Refer to Section 23 09 23.

2.8 LIGHTING MANAGEMENT HUBS

A. Product: Lutron Quantum Light Management Hub or approved equal.

B. Provides in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.

C. Connects to controls and power panels via RS485.

D. Enables light management software to control and monitor relay panels operation.

1. Utilizes Ethernet connectivity to light management computer utilizing one of the following methods:

a. Dedicated network.

b. Dedicated VLAN.

c. Shared network with Building Management System (BMS).

d. Corporate network where managed switches are configured to allow multicasting and use of IGMP.

E. Integrates control station devices, relay panels, preset lighting controls and external inputs into a single customizable lighting control system with:

1. Multiple Failsafe Mechanisms:

a. Power failure detection via emergency lighting interface

b. Protection: Lights go to full on if ballast wires are shorted.

c. Distributed architecture provides fault containment. Single hug failure or loss of power does not compromise lights and shades connected to other lighting management hubs.

2. Manual overrides.

3. Automatic control.

4. Central computer control and monitoring.

5. Integration and BMS via BACnet.

F. Furnished with astronomical time clock.

G. Maintains a backup of the programming in a non-volatile memory capable of lasting more than ten (10) years without power.

H. BACnet Integration License:

1. Provide ability to communicate by means of native BACnet IP communication (does not require interface) to lighting control system from a user-supplies 10BASE-T or 100BASE-T Ethernet network.

2. Requires only one network connection per system.

3. Lighting control system to be BACnet Test Laboratory (BTL) listed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount switches and vacancy sensors as indicated on Drawings.

B. Label each low voltage wire clearly indicating connecting relay panel. Refer to Section 26 05 53.

C. Use only properly color coded, stranded wire. Install wire sizes as indicated on Drawings.

D. Mount relay panels as indicated on Drawings. Wire numbered relays in panel to control power to each load.

E. Identify power wiring with circuit breaker number controlling load. When multiple circuit breaker panels are feeding into relay panel, label wires to clearly indicate originating panel's designation.

F. Terminate communication conductors and associated conduits external to factory supplied equipment.

G. Test relays and switches after installation to confirm proper operation.

H. Label each low voltage wire with relay number at each switch or sensor.

I. Install wiring schedule directory card affixed to rear of panel cover to identify circuits, relays, and loads controlled.

J. Install Work in accordance with 2008 New York City Building Code.

3.2 FIELD QUALITY CONTROL

A. Test relays and switches after installation to confirm proper operation and confirm correct loads are recorded on directory card in each panel.

3.3 MANUFACTURER'S FIELD SERVICES

A. System Startup: Furnish manufacturer trained, factory authorized technician to confirm proper installation and operation of system components.

B. Furnish services of factory trained representative for minimum of 12 days for factory check, test, and start-up supervision. Perform the following services:

1. Check installation of panelboards.
2. Test operation of remote controlled devices.
3. Test operation of telephone override phone lines.
4. Test operation of network connections.
5. Test operation of central operator's station and associated printer.
6. Repair or replace defective components.

C. Programming: Furnish services of factory trained representative to perform programming of system. Assist City of New York personnel in developing control scenario for each application. Program City of New York furnished control scenario.

1. Explain operation of control programs to Owner and conduct demonstration of project.
2. Provide programs on CD Rom.
3. Maintain copy of programmed information at factory.

3.4 ADJUSTING

A. Furnish factory trained technicians to functionally test each system component after installation to verify proper operation.

3.5 DEMONSTRATION

A. Demonstrate operation of the following system components:

1. Index system to occupied cycle and unoccupied cycle.

2. Operation of switches.

3. Operation of each type of occupancy sensors.

B. Furnish services of manufacturer's technical representative for 4 hours to instruct City of New York personnel in operation and maintenance of system. Schedule training with City of New York and provide at least 7 days' notice to Engineer of training date.

END OF SECTION

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SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall switches
2. Device plates

B. Related Sections:

1. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.
2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

B. Underwriter's Laboratories, Inc.:

1. UL 943 – Standards for Ground-Fault Circuit Interrupters.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog information showing dimensions, colors and configurations.

B. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color and finish.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.5 EXTRA MATERIALS

A. Furnish two (2) of each style, size and finish wall plate.

PART 2 - PRODUCTS

2.1 GENERAL

A. Products provided under this Section shall be from one manufacturer for identical catalog items (i.e. receptacles); wherever possible, provide uniformity of manufacturer for similar types of items.

B. Plugs shall be of same manufacturer and grade as receptacles.

C. The color of the wiring devices shall be as selected by the Commissioner from the manufacturer's standard colors.

2.2 WALL PLATES

A. Manufacturers: Subject to the requirement of the specification, the following manufacturer's other products that may be incorporated into the project:

1. Cooper Wiring Devices.
2. Hubbell.
3. Pass & Seymour.
4. Leviton.
5. Lutron.

B. Decorative Cover Plate: 302 stainless-steel. Cover plates for wiring devices installed in millwork shall be selected by the Commissioner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify wall openings are neatly cut and completely covered by wall plates.

B. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install devices plumb and level.

B. All devices in CMU walls shall be flush mounted with concealed conduit runs.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on bottom.

E. Connect wiring devices by wrapping solid conductor around screw terminal. Install solid conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.

F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

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SECTION 26 28 19

ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible.
2. Non-fusible switches.

B. Related Sections:

1. Section 26 05 29 - Hangers and Supports for Electrical Systems.
2. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. Underwriter's Laboratory, Inc:

1. UL-98 - Enclosed and Dead-Front Switches.

1.3 SUBMITTALS

A. Product Data: Submit switch ratings and enclosure dimensions.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allen-Bradley.
2. General Electric Company.
3. Schneider Electric/Square D.
4. Siemens.
5. Or Approved Equal.

2.2 FUSIBLE SWITCH ASSEMBLIES

A. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter switch. Handle lockable in OFF position.

B. Fuse clips: Designed to accommodate only NEMA FU 1, Class R fuses.

C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard enamel unless otherwise noted.

1. Interior Dry Locations: NEMA Type 1.
2. Exterior Locations: NEMA Type 3R.

D. Provide auxiliary contact in each switch for connection to variable speed drive control circuit.

E. Switches shall be furnished with copper isolated neutral bus and copper ground bus in each switch.

F. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Provide neutral bonding provisions for service entrance rated switches.

G. Furnish switches with entirely copper current carrying parts.

2.3 NON-FUSIBLE SWITCH ASSEMBLIES

A. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter switch. Handle lockable in OFF position.

B. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard enamel unless otherwise noted.

1. Interior Dry Locations: Type 1.

2. Exterior Locations: Type 3R.

C. Switches shall be furnished with copper isolated neutral bus and copper ground bus in each switch.

D. Provide auxiliary contact in each switch for connection to variable speed drive control circuit.

E. Furnish switches with entirely copper current carrying parts.

2.4 SWITCH RATINGS

A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

B. Short Circuit Current Rating:

1. UL Class RK-1 fuses – 200,000 RMS symmetrical amperes.

2. UL Class J fuses – 200,000 RMS symmetrical amperes.

3. UL Class L fuses – 200,000 RMS symmetrical amperes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Maintain access to existing enclosed switches and other installations remaining active and requiring access.

3.2 INSTALLATION

A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.

B. Height: 5 feet to operating handle.

C. Connect auxiliary contact to control circuit of variable speed drive to turn off drive when switch is opened.

D. Install engraved plastic nameplates in accordance with Section 26 05 53.

E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4 – Division of Responsibility.

B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1 – Switches, Air, Low-Voltage.

3.4 CLEANING

A. Clean existing enclosed switches to remain.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section specifies requirements for luminaires, lamps and accessories.

B. The Contractor shall provide all labor, materials, equipment and services required to furnish and install all lighting systems, luminaires, lamps, accessories and all related work in strict accordance with the contract documents.

C. The Contractor shall be responsible for all luminaire quantities, lengths and clearances required and shall inform, the Engineer in writing, at the time the bid submission is made, of any discrepancies or variances found with luminaires or details specified herein or in the luminaire schedule and other contract documents, which affect installation or location of luminaires.

1.2 RELATED DOCUMENTS

A. The General Documents and General Requirements apply to this Section. Consult them in detail for applicable instructions.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Raceways and Boxes for Electrical System: Section 26 05 33

B. Low-Voltage Power Conductors and Cables: Section 26 05 19

C. Hangers and Support: Section 26 05 29

1.4 REFERENCE STANDARDS

A. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.

B. New York City Energy Conservation Code.

C. ANSI/NFPA 101 - Life Safety Code.

D. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

E. UL 1598 - Luminaires

1.5 SUBMITTALS

A. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

B. Product Data: Provide luminaire cut sheets with all information including, but not limited to, the following information in a clearly legible manner:

1. Manufacturer's name and address.

2. Catalog number of item.

3. Input voltage.

4. Ballast data, including manufacturer, catalog number, and power factor.

5. All dimensions.

6. Complete information on options.

7. Housing material, thickness, construction, type of finish and available color.

8. Photometric data including coefficient of utilization.

9. Cut sheets of lamps, indicating manufacturer, lamp type, wattage, lamp color and catalog number.

10. Manufacturers catalog cuts will be acceptable only if they represent the luminaire types exactly as specified, without any modifications in construction or electrical characteristic. Catalog cuts shall include luminaire type, luminaire illustration with mounting details, dimensions, materials, components description and certification of suitability for use in locations indicated.

C. When a substitute luminaire is proposed for use in lieu of the specified product, the Engineer may request a sample be submitted in addition to the normal shop drawings. Sample luminaires shall be equipped with lamps and a 10' cord with a ground plug (NEMA 5-15P, 120 volts). All costs for samples shall be the responsibility of the Contractor.

1. In the event sample is approved, then the luminaire submitted and provided under the contract shall be identical with the approved sample luminaire. No luminaire used as a sample will be allowed to

be installed on the project unless directed by Engineer. Samples will not be returned.

2. In the event the submissions are disapproved, the luminaire may be picked up by the Contractor. The Contractor shall immediately make a new submission of a luminaire meeting the contract requirements.

3. Samples shall be labeled with the name of the project, luminaire type and a description of the submitted item. Samples will not be returned.

4. Upon request, the Contractor shall install, at no cost to the City of New York, the submitted samples at the location designated by the Engineer.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Upon request, furnish for review by the Engineer, an itemized schedule of unit equipment costs for all luminaire types to be provided under the contract.

G. Submit a list of all interior spaces with the respective luminaire type and ceiling type scheduled to be installed within the space. The purpose of this list is to insure proper coordination between ceiling type and luminaire trim.

1.6 QUALITY ASSURANCE

A. Materials, equipment and appurtenances as well as workmanship provided under this Section shall conform to the highest commercial standards as specified herein and as indicated on the Drawings. Luminaire parts and components not specifically identified or indicated shall be made of materials most appropriate to their use or function and resistant to corrosion and thermal and mechanical stresses encountered in the normal application and function of the luminaires.

B. All lamps of a given type shall be the product of one manufacturer.

C. All ballasts for luminaires of a given type shall be product of one manufacturer.

1.7 DELIVERY AND HANDLING

A. All lighting equipment delivered to the project shall be complete, including mounting devices, ballasts, sockets, transformers, wiring and any other components necessary for the proper operation and installation of the equipment. All luminaires shall be assembled, wired and equipped, at place of manufacture.

B. Reflector cones, baffles, louvers, lenses and decorative elements of luminaires shall be packed separate from the luminaire housing by the Manufacturer.

C. All luminaires, when installed shall be free of dents, warps, light leaks and any other irregularities. Blemished, damaged or unsatisfactory luminaires shall be replaced in a manner satisfactory to the Commissioner.

D. Reflectors, cones or baffles shall be absolutely free of indentations, finger prints, dents, warps, and any other irregularities caused by shipping, manufacturing or installation process.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI and 2011 New York City Electrical Code.

B. Conform to requirements of the New York City Building Code.

C. Conform to requirements of the New York City Energy Conservation Code.

D. National Appliance Energy Conservation Act of 1987, Amendments of 1988 (Public Law 100-357 dated June 28, 1988): Requirements for Energy Efficient Ballasts.

E. The Energy Policy Act of 1992.

F. Furnish products listed and classified by a Nationally Recognized Testing Laboratory (NRTL) as suitable for purpose specified and shown. NRTL's are defined under the regulations of the Occupational Health and Safety Administration (OSHA).

1.9 EXTRA MATERIALS

A. Provide two of each plastic or tempered glass lens.

B. Provide one case of replacement lamps for each fluorescent lamp type installed. Minimum quantity of lamps shall be 24 of each type, unless otherwise specified.

C. Provide two of each ballast type.

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. General: Provide luminaires of sizes, types and ratings, indicated or scheduled; complete with, but not limited to, housings, solid-state electronic ballasts, drivers, starters, wiring and lamps.

B. Provide thickness of sheet metal so that all luminaires are rigid, stable and will resist deflection, twisting, warping under normal installation procedures, re-lamping and maintenance.

1. All luminaire housings shall be made of code gauge sheet steel, unless a heavier gauge is specified.

2. Tempered glass lenses shall be 1/4" thick minimum.

C. Manufacture luminaires to the specifications described above and hereafter and as indicated in the luminaire schedule, drawings and all contract documents.

D. The luminaire schedule contains a general description of the luminaire construction requirements. Manufacturers' catalog numbers are provided to indicate the luminaire series and options specified. Where a conflict exists between the written description and the model number, the Contractor shall request clarification from the Engineer.

E. Minor details, not usually indicated on the drawings nor specified, but that are necessary for the proper execution and completion of the luminaires, shall be included, the same as if they were herein specified or indicated on the Drawings.

F. All luminaire designs shall include as applicable, plaster frames, trim rings, shrouds, flanges, backboxes, support hardware and any other components required for a complete and proper installation of the luminaires. The Contractor shall coordinate with members of other trades, ceiling or mounting surface construction, trim and any other pertinent details, as applicable.

G. The Contractor shall coordinate and detail all necessary structural supports and support hardware required for the safe attachment of all luminaires to mounting surfaces.

H. Provide neoprene gaskets, stops and barriers where required to prevent light leak or water and water vapor penetration.

I. Provide finished product with smooth ground metal edges; tight fitting connections, hinges, closures; clean, trims and frames.

J. Provide access for servicing the installed luminaire and for replacement of electrical components without requiring removal of the luminaire.

2.2 GENERAL LUMINAIRE CONSTRUCTION

A. Fluorescent luminaire housings shall be die-formed of code gauge sheet steel (minimum) or as specified, with integral end plates and trim flanges, coordinated with ceiling construction unless otherwise noted. Socket plates shall be of the same gauge as housing. Wireway covers shall provide ready access to electrical components without the use of tools. All metal parts shall be cleaned, primed and finished after fabrication to prevent corrosion. Finish with a high reflectance, white powder coat baked enamel, unless otherwise noted. All units shall carry the UL label.

B. All materials, accessories, and other related luminaire parts shall be new and free from defects which in may impair their character, appearance, strength, durability and function.

C. Enclosed luminaire doors shall be provided as follows:

1. Positive light seal.

2. Concealed safety hinges.

3. Inconspicuous "positive spring loaded" holding latches.

4. Hinge shall be capable of being installed on either side of the luminaire.

5. Removable without use of tools.

2.3 SURFACE MOUNTED LUMINAIRE

A. Surface mounted luminaire shall be provided with required mounting stand-off brackets and accessories. Locations of luminaires in mechanical areas shall be coordinated with Mechanical Contractor.

2.4 FINISHES

A. Completely form painted reflectors before application of primer and enamel color coat or coats. Reflectors and reflector bodies for fluorescent lamp luminaires having baked-on white synthetic enamel finish shall be made of steel of the thickness specified and given a suitable primer and white color coat or coats properly applied to meet the following requirements and tests:

1. Initial reflection factor shall be not less than 92%.

2. Exposure to 100% humidity at 110°F, for 100 hours (Cook Box Test) shall demonstrate no blistering or other effect.

3. Except for stainless steel give ferrous metal surfaces a five-stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.

2.5 LENSES

A. Glass used for lenses shall be impact and heat-resistant tempered borosilicate glass. The glass shall be crystal clear in quality with a transmittance of not less than 88%, unless otherwise indicated.

B. Where optical lenses are used, they shall be free from spherical and chromatic aberrations and other imperfections which may hinder the functional performance of the lenses.

C. All lenses, louvers, or other light diffusing elements shall be removable, but positively held so that hinge or other normal motion will not cause them to drop out.

D. All lenses shall be installed (turned over to the Owner) clean and free of dust or finger prints.

E. All lenses are subject to Engineer's approval.

2.6 BALLASTS

A. General: Ballasts shall be compatible with the specified lamps. The input voltage shall be compatible with the building voltage as indicated on the Contract Drawings.

B. Fluorescent, full output type.

1. Description: Ballasts shall be Instant-Start, solid-state electronic, high-frequency, full output type for use on 265mA, T8 LED lamps. Ballasts shall provide normal rated life for specified lamps and shall be equipped with end-of-life lamp shut-off circuitry. The end-of-life circuitry shall automatically reset when new lamps are installed.

2. Harmonic Distortion: Total harmonic distortion shall not exceed 10 percent.

3. Electronic ballasts shall operate 1 or 2 lamp combinations as indicated in the luminaire schedule. Ballasts shall be parallel wire type.

4. Ballast Factor: .87 minimum.

5. Power Factor: .95 or higher.

6. Lamp Current Crest Factor: 1.7 maximum (ANSI standard).

7. Sound Rating: 'A' or better.

8. Other Requirements: UL listed, ETL certified, Class 'P' thermally protected, PCB free, output frequency greater than 20KHz.

9. Line Transient Withstand: ANSI/IEEE C62.41, Category A.

10. Warranty: One full year from the date of acceptance for parts and replacement labor.

11. Acceptable Manufacturers: Advance, Universal, Osram-Sylvania.

C. Compact Fluorescent, Full Output Type.

1. Description: Ballasts shall be solid-state electronic, high-frequency, programmed start, full output type for use with T-4, four-pin compact fluorescent lamps. Ballasts shall provide normal rated life for specified lamps and shall have end-of-life lamp shut-off circuitry. The end-of-life circuitry shall automatically reset when new lamps are installed.

2. Harmonic Distortion: Total harmonic distortion shall not exceed 10 percent.

3. Electronic ballasts shall operate 1 or 2 lamp combinations as indicated in the luminaire schedule. Ballasts shall be parallel wire type.

4. Input Voltage: 120/277 (dual voltage).

5. Ballast Factor: .87 minimum.

6. Power Factor: .95 or higher.

7. Lamp Current Crest Factor: 1.7 maximum (ANSI standard).

8. Sound Rating: 'A' or better.

9. Other Requirements: UL listed, ETL certified, Class 'P' thermally protected, PCB free, output frequency greater than 40 KHz.

10. Line Transient Withstand: ANSI/IEEE C62.41, Category A.

11. Warranty: One full year from the date of acceptance for parts and replacement labor.

12. Acceptable Manufacturers: Advance, Universal, Osram-Sylvania.

D. Emergency Ballasts

1. Description: Ballasts shall be compatible with LED T8 bulbs. Emergency Ballasts shall provide emergency power to bulb for not less than 90 minutes.

2. 2-Wire Illuminated test switch shall be provided.

3. Other Requirements: UL listed.

4. Input Voltage: 120/277 (dual voltage).

5. Warranty: Minimum five years from the date of acceptance for parts and replacement labor.

6. Acceptable Manufacturers: Philips Bodine, or acceptable equivalent.

2.7 LAMPS

A. LED Lamps

1. All LED lamps shall be direct replacement T8-LED tubes with internal driver, designed to work with instant start fluorescent ballasts.

2. Color Temperature: 4100K

3. Input Voltage: 120/277 (dual voltage).

4. Other Requirements: UL listed.

5. Warranty: Minimum one full year from the date of acceptance for parts and replacement labor.

6. Acceptable Manufacturers: Philips, Overdrive Lighting, Osram-Sylvania.

B. Other lamps

1. All other lamps shall be provided as indicated in the lighting schedule.

2. Acceptable Manufacturers: General Electric, Osram-Sylvania. Phillips.

2.8 WIRING

A. All wiring shall comply with the following:

1. All wiring within luminaires or from the luminaire to the splice with the building wiring shall be as specified under "WIRES AND CABLES".

2. Wiring shall be concealed within the luminaire construction except where the luminaire design or mounting dictates otherwise.

3. Joints in wiring within luminaires and connections of the luminaire wiring to the wiring of the building shall be as specified in Section 26 05 19.

4. Wiring channels and wireways shall be free from projections, screw points and rough or sharp edges throughout, and all points or edges over which conductors may pass and be subject to injury or wear shall be rounded or bushed.

5. Insulated bushings shall be installed at points of entrance and exit of wiring.

6. Splices in internal wiring shall be made with approved insulated "Wire Nut" type mechanical connectors, suitable for the temperature and voltage conditions to which they will be subjected.

7. All luminaires shall be completely wired at the factory.

8. All luminaires shall be properly grounded using the branch circuit grounding conductor as required by 2011 New York City Electrical Code.

9. Secure ballasts or drivers firmly in luminaire to prevent vibrations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate and supporting grids for luminaires.

B. Examine each luminaire to determine suitability for lamps specified.

3.2 INSTALLATION

A. Provide luminaires at locations and of types as indicated on the Contract Drawings.

B. Coordinate luminaire locations with Architectural Plans, reflected ceiling plans and other reference data prior to installation.

C. Each luminaire shall be packaged with complete instructions and illustrations showing how to install. Install luminaires in strict conformance with the manufacturer's recommendation and instructions.

D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

E. Install wall mounted luminaires at height as indicated on Drawings.

F. Install accessories furnished with each luminaire.

G. Connect luminaires to existing branch circuit that became available after removal of existing luminaires.

H. Make wiring connections to branch circuit using building wire or cable with insulation suitable for temperature conditions within luminaire.

I. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

J. Install specified lamps in each luminaire.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

B. Replace blemished, damaged or unsatisfactory luminaires as directed.

3.4 ADJUSTING

A. Re-lamp luminaires that have failed lamps at Substantial Completion.

3.5 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosure.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

END OF SECTION

FMS ID: **E12-0023**

NEW YORK CITY DEPARTMENT OF DESIGN + CONSTRUCTION

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

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

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

CONTRACT NO. 1 **HVAC WORK**

PlaNYC Energy Audit Retrofit at Brooklyn Public Library

LOCATION: **2 Eastern Parkway**
BOROUGH: **Brooklyn 11238**
CITY OF NEW YORK

C.D.E. Air Conditioning Co., Inc.

Contractor

Dated _____, 20____

Entered in the Comptroller's Office

First Assistant Bookkeeper

Dated _____, 20____