



George Latimer, Westchester County Executive

**General Requirements and Proposals
Information for Bidders
General and Special Clauses
Technical Specifications**

**LOW RISE BUILDING RENOVATIONS AND
HVAC IMPROVEMENTS - PHASE II
110 DR. MARTIN LUTHER KING, JR. BOULEVARD
WHITE PLAINS, NEW YORK**

VOLUME 1 OF 2

Contract No. 20-502

Bid Opening: February 14, 2024

By Bidder (Please Print)

Firm/Business Name: _____

Address: _____

For Official Use Only

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

Division of Engineering

NOTICE TO CONTRACTORS

County of Westchester
New York

SPECIAL NOTICE

County of Westchester
New York

ADDENDA TO THE BID DOCUMENTS

Addenda to the Bid Documents will be published on the Empire State Purchasing Group website at (<http://www.bidnetdirect.com/new-york>) **It is the responsibility of each potential bidder to check the website on a regular basis for further information relative to the bid documents including information relating to any and all addenda** prior to submitting its bid. All Bidders are deemed to have reviewed and considered all addendums in their Bid.

SUBMISSION OF BIDS

Bidders should not submit the entire bid document with its bid submission. Instead, each bidder is required to submit the full set of designated Proposal Pages. The Proposal Pages are denoted by a border and are titled on the bottom as “Proposal Page ____”. The Proposal Pages must be accompanied by the “Bid Bond and Consent of Surety” (as set forth in the Proposal Pages) attached to the outside of the sealed bid. A Bid Bond is NOT required for contracts of \$100,000 or less. Failure to submit in this manner may cause the bid to be rejected.

The successful bidder will be required to furnish a Performance and Payment Bond.

SPECIAL NOTICE

County of Westchester
New York

MANDATORY PRE-BID SITE INSPECTION

- A. Superseding the first paragraph of Article “3. PRE-BID SITE INSPECTION” of the Information for Bidders, Bidders are required to attend a Mandatory Pre-Bid Site Inspection at 10:00 a.m. on Tuesday, January 30, 2024 at 110 Dr. Martin Luther King Jr Blvd, White Plains, NY, at which time they will examine the work site under escort by the County’s representative.

BIDS FROM CONTRACTORS NOT IN ATTENDANCE AT THIS MEETING, OR THOSE WHO FAIL TO SIGN THE ATTENDANCE SHEET-WILL BE *REJECTED*

- B. Bidders shall indicate their interest in the Mandatory Pre-Bid Site Inspection by contacting Adam Kaplinski, R.A., Department of Public Works, Division of Engineering at 914-995-3991.
- C. All other portions of Article “3. PRE-BID SITE INSPECTION” of the Information for Bidders shall remain in full force and effect.

SPECIAL NOTICE

County of Westchester
New York

JOINT VENTURES OR CONTRACTORS COMPRISED OF MORE THAN ONE LEGAL ENTITY

- (a) If the Contractor is a joint venture or otherwise comprised of more than one legal entity or any group of partners, participants or joint ventures associated for the purpose of undertaking this agreement, each such entity, partner and/or participant acknowledges and hereby affirmatively represents and agrees that each has the power to bind the Contractor and each of the others hereunder; and as such, each acts both as principal and agent of the Contractor and of each of the others hereunder. Each further acknowledges and agrees that all such entities, participants and/or partners of the joint venture associated for the purposes of undertaking this agreement expressly agree to be jointly and severably liable for any and all obligations and/or liabilities of the Contractor arising in any way out of and in connection with this agreement.
- (b) If the Contractor is a joint venture, or otherwise comprised of more than one legal entity or any group of partners, participants or joint ventures associated for the purposes of undertaking this agreement, the Contractor represents and warrants to the County that it is duly organized under the laws of the State of New York, and that each and every entity, partner, participant or joint venture of Contractor agrees to separately execute the agreement, by its own authorized representative, with the appropriate acknowledgment and verification.
- (c) If the Contractor is a joint venture or otherwise comprised of more than one legal entity or any group of partners, participants or joint ventures associated for the purpose of undertaking this agreement, either at least one such entity, partner and/or participant comprising the Contractor and on behalf of the Contractor or the Contractor itself, shall comply with all requirements of the bid specifications herein and prerequisites to submit a bid, including but not limited to attendance of any mandatory pre-bid meetings, if any, and obtaining the bid documents and any addenda from the Empire State Purchasing Group website, or any successor website for posting of bid documents.
- (d) If the Contractor is a joint venture or otherwise comprised of more than one legal entity or any group of partners, participants or joint ventures associated for the purposes of undertaking this agreement, each such entity, partner and/or participant acknowledges and hereby affirmatively represents and agrees that the respective rights, duties and liabilities of each hereunder shall be governed by the laws of the State of New York, including but not limited to the New York Partnership Law.

SPECIAL NOTICE

County of Westchester
New York

MINORITY PARTICIPATION POLICY

Contractors must comply with the County's Minority Participation Policy, including, but not limited to, the requirement that contractors make a demonstrated good faith effort to utilize Minority Owned Businesses ("MOB") and Women Owned Businesses ("WOB") (see IFB Article 36). To assist contractors in this effort the County has made available a list of MOB and WOB at <http://mwbe.westchestergov.com/> Contractors are also encouraged to utilize other sources to identify potential MOB and WOB as subcontractors and suppliers.

All bidders must submit as part of their bid package the Minority/Women Owned Business Enterprise Questionnaire located in the Proposal Page section of the bid documents.

SPECIAL NOTICE

County of Westchester
New York

INSURANCE REQUIRED:

In addition to the insurance requirements listed in Section 2 of the Information for Bidders, the Contractor, at their own cost and expense, shall provide and maintain the following:

BUILDERS RISK INSURANCE

The Contractor must provide and maintain a **Builder's Risk Form, All Risk Insurance Contract**. The coverage shall be written for **100% of the completed value**, with the County of Westchester named as loss payee as its interest may appear. In formulating its proposal, the Contractor shall include the costs for this coverage. In the event that claims, for which the County may be liable, in excess of the insured amounts provided herein are filed by reason of Contractor's negligent acts or omissions under the Agreement or by virtue of the provisions of the labor law or other statute or any other reason, the amount of excess of such claims or any portion thereof, may be withheld from payment due or to become due the Contractor until such time as the Contractor shall furnish such additional security covering such claims in form satisfactory to the County of Westchester.

OWNERS PROTECTIVE LIABILITY POLICY

Contractor must provide an Owners Protective Liability Policy naming the County of Westchester as insured, with a minimum limit of liability per occurrence of \$3,000,000.

NOTE: Owners And Contractors Protective Liability (OCP) coverage is required for work involving climbing, scaffolding, cranes, or other lift devices.

SPECIAL NOTICE

County of Westchester
New York

CHANGES IN THE WICKS LAW

Effective July 1, 2008, construction contracts of one million five hundred thousand dollars or less will not require the preparation of separate contracts for plumbing and gas fitting; steam heating, hot water heating, ventilation and air conditioning apparatus; and electric wiring and standard illuminating fixtures and general construction.

Each bidder on a public work contract, where the preparation of separate contracts is not required shall, to the full extent applicable, submit with its bid a separate sealed list that names each Subcontractor that the bidder will use to perform work on the contract and the agreed upon price to be paid to each for (a) plumbing and gas fitting, (b) steam heating, hot water heating, ventilating and air conditioning apparatus and (c) electric wiring and standard illuminating fixtures and (d) general construction. The submission (Proposal Page 6) that contains the agreed upon price shall be acknowledged by both Contractor and Subcontractor. For purposes of this paragraph, the acknowledgment from the Subcontractor may contain the facsimile signature of an officer of the Subcontractor.

After the low bid is announced, the sealed list of subcontractors submitted with the bid shall be opened and the names of such subcontractors shall be announced. Thereafter, any changes of subcontractors or agreed-upon amount to be paid to each shall require the approval of the County upon a showing of legitimate construction need for such change.

The Successful low bidder, before award of the contract, must procure and provide to the County, from each of the above denoted Subcontractors, a Contract Disclosure Statement and the Required Disclosure of Relationships to County forms.

The sealed lists of Subcontractors submitted by unsuccessful bidders shall be destroyed after the contract award.

THIS PROJECT IS NOT SUBJECT TO THE REQUIREMENTS OF THE “WICKS LAW”. ACCORDINGLY, EACH BIDDER IS REQUIRED TO SUBMIT SPECIFIC INFORMATION PERTAINING TO ITS PROPOSED SUBCONTRACTORS. PLEASE SEE THE “NOTICE TO CONTRACTORS” THAT FORMS A PART OF THESE BID DOCUMENTS.

SPECIAL NOTICE

County of Westchester
New York

COMPLETION OF GRANT FUNDING FORMS

The bidders are hereby notified that if this project, or any portion thereof, is funded by a grant then the contractor will be responsible to complete all appropriate forms as required by the grant agency in order to complete the application.

PROMPT EXECUTION AND RETURN OF CONTRACT

- A. The successful bidder is required to return the completed contract to the County within ten (10) days of receipt of the execution copy of the contract. The contract must be signed, notarized and returned to the County with all insurance certificates, bonds and supporting documentation, including all required Subcontractor information.
- B. The County reserves all of its rights, including, but not limited to, proceeding against the bid bond, if the successful bidder fails to submit the complete executed package within the above time frame.

SPECIAL NOTICE

County of Westchester
New York

PROOF OF PAYMENT BY CONTRACTOR TO SUBCONTRACTORS AND MATERIALMEN.

In addition to and without limiting any of the provisions set forth in Section 23 of the Information for Bidders, after the Contractor completes 50% of the work under the contract, the Contractor may be required to supplement each requisition submitted to the County with documentation that establishes that the Contractor has timely and properly paid its subcontractors and materialmen as required by Section 23 of the Information For Bidders. Such documentation may include copies of both sides of cancelled check(s) paid to the order of the subcontractors and materialmen and such other documentation as may be reasonably requested by the Commissioner. If the Contractor fails to submit such documentation, the Commissioner may, in his sole discretion, withhold payment of the requisition until such time as the documentation is properly submitted. Nothing herein is intended or shall be construed to confer upon or give any subcontractor or materialman, or its successors and assigns, any third party beneficiary rights, remedies or basis for reliance upon, under or by reason of the contract or this Special Notice provision.

SPECIAL NOTICE

County of Westchester
New York

PREVAILING WAGE

All public works contracts are subject to the payment of the prevailing wage and supplements as set forth by the laws of the State of New York, including, but not limited to, Articles 8 and 9 of the New York Labor Law (the "Prevailing Wage Laws"). Westchester County has an active Prevailing Wage Enforcement Officer who enforces the Prevailing Wage Laws within the County for public works contracts, including reviewing certified payroll records, visiting job sites, interviewing the employer and employees (See IFB Article 12) and, if necessary, requesting copies of cancelled checks.

Any Contractor who fails to comply with the Prevailing Wage Laws, including, but not limited to, failing to pay the prevailing wage rates and supplements, failing to submit certified payroll records to the County or failing to post the prevailing wage rates and supplements at the work site, will be subject to enforcement as provided for in the Contract and laws of the State of New York through the Westchester County District Attorney's office, the Commissioner of the New York State Department of Labor, the County and/or the employee who suffered the underpayment. This enforcement could include, but is not limited to, criminal penalties, civil penalties, debarment from future bid awards, the withholding of payment under the Contract to satisfy the unpaid wages and supplements, including interest and civil penalty. In addition, such a failure shall constitute grounds for cancellation of the Contract (IFB 8(C)). Moreover, a prime contractor is responsible for its subcontractor's failure to comply with, or evasion of, the provisions of the Prevailing Wage Laws.

SPECIAL NOTICE

County of Westchester New
York

MANDATORY OSHA CERTIFICATION

When a public works contract is in excess of \$250,000.00, all employees are required to have successfully completed the OSHA 10 hours training class. All contractors and subcontractors must attach copies of proof of completion of the OSHA 10 hour course by all employees to the first certified payroll submitted to the County and on each succeeding payroll where any new or additional employee is first listed. Employees may be requested by the County's representative to verify compliance with the OSHA 10 hour course by showing their OSHA card.

When a public works contract is in excess of \$1,000,000.00, all employees are required to have successfully completed the OSHA 30 hours training class. All contractors and subcontractors must attach copies of proof of completion of the OSHA 30 hour course by all employees to the first certified payroll submitted to the County and on each succeeding payroll where any new or additional employee is first listed. Employees may be requested by the County's representative to verify compliance with the OSHA 30 hour course by showing their OSHA card.

In addition, on any contract that includes excavation of underground facilities, the excavator is required to be certified and have completed the training and education program provided by the one-call notification system (Dig Safely New York, Inc. Certified Excavator Program in Safe Digging Best Practices) or any other provider authorized by the public service commission to administer such training and education program.

SPECIAL NOTICE

County of Westchester
New York

PROJECT LABOR AGREEMENT (PLA)

- A. The County of Westchester has determined that a Project Labor Agreement will be used on this Project. The successful bidder will be required as a condition of this Contract to execute the PLA with the Building and Construction Trades Council of Westchester and Putnam Counties, New York, AFL-CIO ("Council"). The PLA will be substantially in the same form as the PLA included in this contract specification book. Bidders are urged to familiarize themselves with the terms and conditions of the PLA.
- B. It should be noted that Schedule A of the PLA contains a list of the local unions affiliated with the Council. Copies of the applicable Collective Bargaining Agreements of the local unions can be obtained by writing to the Building and Construction Trades Council of Westchester and Putnam Counties, New York, AFL-CIO at 258 Saw Mill River Road, Elmsford, New York 10523, Attn.: Carol A. Boccardi.

NOTICE TO CONTRACTORS

County of Westchester
New York

Sealed proposals for the following construction work:

CONTRACT NO: 20-502

ADVERTISING: January 19, 2024

MANDATORY PRE-BID INSPECTION: January 30, 2024

LOW RISE BUILDING RENOVATIONS AND HVAC IMPROVEMENTS - PHASE II 110 DR. MARTIN LUTHER KING, JR. BOULEVARD WHITE PLAINS, NEW YORK

will be received by the Board of Acquisition and Contract in Room 528, Michaelian Office Building, 148 Martine Ave., White Plains, New York until 11:00 a.m., **Wednesday, February 14, 2024**, and immediately thereafter, the bids will be publicly opened and read aloud in Room 527 of the said building. The bid opening also will be made accessible to the public via the livestreaming service WebEx. The livestreaming of the bid opening via WebEx is in addition to and not in place of the publicly bid opening to be held in Room 527 of the Michaelian Office Building. For additional bidding information or questions call (914) 995-2274.

Instructions for livestreaming via WebEx. Attendees may join by computer browser at <https://westchestergov.webex.com/meet/bac-bidopening> or by phone 1-415-655-0001 US Toll or 1-844-621-3956 US Toll Free. The Access Code is 614 981 028.

The Bid Documents (General Requirements, Information for Bidders, Technical Specifications, etc. with Authorized Proposal Pages) **MUST BE OBTAINED from the Empire State Purchasing Group website at the following web address:**

<http://www.bidnetdirect.com/new-york>.

There is no cost to the bidder for this service. Bid documents will be available after 1:00 p.m. on the advertising date.

PLEASE TAKE NOTICE: IN ORDER TO SUBMIT A BID, BIDDERS MUST REGISTER AND DOWNLOAD THE BID DOCUMENTS FROM THE EMPIRE STATE PURCHASING GROUP WEBSITE AND MUST REGISTER USING THE NAME OF THE PERSON OR BUSINESS ENTITY THAT WILL BE SUBMITTING THE BID. IN ORDER TO ENSURE THAT COUNTY BID DOCUMENTS HAVE NOT BEEN ALTERED IN ANY WAY, THE COUNTY WILL NOT ACCEPT BIDS FROM PERSONS OR BUSINESS ENTITIES THAT HAVE NOT FOLLOWED THIS REQUIREMENT.

The Bid Documents include Contract Drawings which **MAY BE OBTAINED at no cost on the Empire State Purchasing Group website at the following web address:** <http://www.bidnetdirect.com/new-york>, after 1:00 p.m. on the advertising date.

If the bidder is unable to utilize the electronic version of the Contract Drawings that are available on the Empire State Purchasing Group Website, the bidder may purchase copies of the Contract Drawings. Contract Drawings may be obtained from the Office of the Board of Acquisition and Contract at the above address after 1:00 p.m. on the advertising date and between the hours of 9:00 a.m. to 4:00 p.m. Monday thru Friday. Copies of the Contract Drawings shall be made available upon payment of a personal check, company check or money order made payable to the County of Westchester, in the amount of **\$100.00** per set. For bidders, the deposit for each set of drawings will be refunded in full if returned in good condition within thirty days after award or rejection of bids. For non-bidders, only fifty percent of the deposit will be refunded. No refunds will be made to the successful bidder.

Each bidder is required to submit the full set of authorized Proposal Pages and all bids over **\$100,000.00** must also be accompanied by the "Bid Bond and Consent of Surety" (as set forth in the Proposal Pages) attached to the outside of the sealed bid. Failure to submit in this manner may cause the bid to be rejected. **The successful bidder, no matter the amount of its bid, will be required to furnish a Performance and Payment Bond with its signed contract.**

To the full extent applicable, each bidder shall submit with its bid a separate sealed list that names each Subcontractor that the bidder will use to perform work on the contract and the agreed upon price to be paid to each for: (a) plumbing and gas fitting, (b) steam heating, hot water heating, ventilating and air conditioning apparatus and (c) electric wiring and standard illuminating fixtures and (d) general construction. The submission (Proposal Page 41) that contains the agreed upon price shall be acknowledged by both Contractor and Subcontractor. For purposes of this paragraph, the acknowledgment from the Subcontractor may contain the facsimile signature of an officer of the Subcontractor.

The Successful low bidder, before award of the contract, must obtain and provide to the County, from each of the above denoted Subcontractors, fully completed and signed Contract Disclosure Statement (Proposal Pages 24-32) and Required Disclosure of Relationships to County (Proposal Pages 33) forms.

The sealed lists of Subcontractors submitted by unsuccessful bidders shall be destroyed, unless you request that it be returned by checking the applicable box on Proposal Page 5.

The County of Westchester reserves the right to waive any informalities in the bids, or to reject any or all bids. No bidder may withdraw its bid within forty-five (45) days after the date of the bid opening.

Pursuant to Chapter 308 of the Laws of the County of Westchester, it is the goal of the County to use its best efforts to encourage, promote, and increase the participation of business enterprises owned and controlled by persons of color or women - Minority Business Enterprise (MBE) and Women Business Enterprise (WBE).

REMINDER: All required licenses should be submitted with the Bid.

COUNTY OF WESTCHESTER, NEW YORK
DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

BY: Hugh J. Greechan, Jr., P.E., Commissioner

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Contract Drawings	Contract Drawings 1
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- 220518 ESCUTCHEONS FOR PLUMBING PIPING
- 220523 GENERAL-DUTY VALVES FOR PLUMBING PIPING
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- 220553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
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- 221116 DOMESTIC WATER PIPING
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- 230513.1 VARIABLE-FREQUENCY MOTOR CONTROLLERS
- 230516 EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
- 230517 SLEEVES AND SLEEVE SEALS FOR MECHANICAL PIPING
- 230518 ESCUTCHEONS FOR HVAC PIPING
- 230519 METERS AND GAGES FOR HVAC PIPING
- 230523 GENERAL-DUTY VALVES FOR HVAC PIPING
- 230529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
- 230548 VIBRATION ISOLATION, WIND & FLOOD LOAD RESTRAINTS FOR HVAC,
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- 230553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
- 230593 TESTING, ADJUSTING, AND BALANCING FOR HVAC
- 230700 HVAC INSULATION
- 230800 MECHANICAL COMMISSIONING
- 230900 CONTROLS FOR HVAC SYSTEMS
- 230993 SEQUENCE OF OPERATIONS
- 232113 HYDRONIC PIPING
- 232123 HYDRONIC PUMPS
- 232300 REFRIGERANT PIPING
- 232500 HVAC WATER TREATMENT
- 233113 DUCTWORK
- 233300 AIR DUCT ACCESSORIES
- 233416 HVAC FANS
- 233600 AIR TERMINAL UNITS
- 233713 DIFFUSERS, REGISTERS, AND GRILLES
- 234100 PARTICULATE AIR FILTRATION
- 237313 MODULAR INDOOR CENTRAL STATION AIR-HANDLING UNITS

238126 MULTIPLE EVAPORATOR DX SPLIT SYSTEM HEAT PUMPS
238219 FAN COIL UNITS, CABINET HEATERS, AND UNIT HEATERS
238233 RADIATORS AND CONVECTORS

DIVISION 26 - ELECTRICAL

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260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
260544	SLEEVES FOR RACEWAYS AND CABLES
260548	VIBRATION ISOLATION, WIND & LOAD RESTRAINTS FOR HVAC, PLUMBING & ELECTRICAL COMPONENTS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
260573	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
260801	ELECTRICAL TESTING
260923	LIGHTING CONTROL DEVICES
262200	LOW-VOLTAGE TRANSFORMERS
262413	SWITCHBOARDS
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1. **GENERAL REQUIREMENTS AND PROPOSALS**

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

Division of Engineering

GENERAL REQUIREMENTS

1. DESCRIPTION OF THE WORK

Work under this Contract includes all necessary labor, materials and equipment required to:

Provide all necessary labor, material and equipment required to provide building renovations and HVAC Improvements including various general contractor work, acoustical ceiling replacement, wall finishes, painting, insulation, flooring, tiles, bathroom fixture replacement. elevator upgrades and lighting, including related work, etc. as depicted on project drawings and specifications.

It is not intended that this description of work mention each particular item required, but that it give information concerning the general scope and areas of work for the convenience of the bidders.

THIS PROJECT IS NOT SUBJECT TO THE REQUIREMENTS OF THE “WICKS LAW”. ACCORDINGLY, EACH BIDDER IS REQUIRED TO SUBMIT SPECIFIC INFORMATION PERTAINING TO ITS PROPOSED SUBCONTRACTORS. PLEASE SEE THE “NOTICE TO CONTRACTORS” THAT FORMS A PART OF THESE BID DOCUMENTS.

GENERAL REQUIREMENTS

2. SUBCONTRACTING & DIRECT EMPLOYMENT OF LABOR

The Contractor shall not subcontract more than ninety (90%) percent of its bid. The Contractor must directly employ at least ten (10%) percent of the personnel working on this contract as measured in man-days worked.

“Directly employ” shall be construed to include only workers employed and paid directly by the Contractor, usually for wages or salary.

The Contractor expressly acknowledges that any violation of this provision constitutes a default under this contract.

3. REQUIRED TIME FOR COMPLETION OF THE WORK

Notification to commence the work will require the mandatory submission of all the executed contracts and the Certificates of Insurance after receipt of authority to award.

The Contractor shall commence the work embraced in this contract within ten (10) days of the service of Notice by the County to do so and shall complete the said work within 540 consecutive calendar days computed from the date of such Notice to commence.

GENERAL REQUIREMENTS

4. SECURITY REGULATIONS

Security Regulations For all County Facilities except County Correctional Facilities:

- A. Contractor's attention is called to the fact that this work is to be performed on property which is the responsibility of the County; therefore, all personnel associated with this contract are subject to special conditions affecting security and control of the facilities operations. Every person required to enter the work site will be issued an ID card and be required to fill out appropriate applications. **There is a \$30.00 processing fee for each lost ID card**; remitted by check made payable to the County of Westchester. All ID processing will be scheduled by the Construction Administrator.
- B. The Contractor/Subcontractor shall issue a copy of the security regulations (Paragraph C) to all personnel engaged on this project.
- C. All Contractor/Subcontractor personnel shall be bound by the following security regulations for the duration of this contract.
 - 1) All personnel must conspicuously display the ID card and identify themselves upon request.
 - 2) If an ID card is misplaced or lost, report this immediately to the Inspector.
 - 3) All Contractor/Subcontractor personnel are responsible for all tools and equipment and you must report any loss immediately to the Construction Administrator.
 - 4) All personnel must observe all orders of the Owner.
 - 5) All personnel are to report any unusual incidents or problems to the Construction Administrator immediately.
 - 6) All personnel shall not possess or consume any alcoholic beverage or illegal drug or medication while on the property, or report to work under the influence of alcohol or drugs.
 - 7) Any vehicle left on the property must be locked and the ignition keys must be removed. Vehicles will not be left overnight without prior approval.
 - 8) All personnel shall not enter any other areas of the premises (except the areas agreed to) without prior approval of the Construction Administrator.

Security Regulations For County Correctional Facilities:

- A. Contractor's attention is called to the fact that this work is to be performed on property adjacent and/or within the County's Correctional Facilities; therefore, all personnel associated with this project are subject to special conditions affecting security and control of the Correctional Facility Operations. Every person required to enter the work site will be fingerprinted, processed for a photo ID card and be required to fill out appropriate applications. **There is a \$100.00 processing fee for each person**, checks made payable to the Commissioner of Finance. All ID processing will be scheduled by the Construction Administrator.

GENERAL REQUIREMENTS

- B. All Contractors and Subcontractors shall issue a copy of the security regulations (Paragraph C) to all personnel to be engaged on this project.
- C. All Contractor's and Subcontractor's personnel shall be bound by the following security regulations for the duration of this project.
 - 1) All personnel entering the Penitentiary, Jail or Women's Unit must stop and identify themselves to the Control or Desk Officer who will issue the appropriate pass after ascertaining that they have been cleared to enter the facility. Only workers with valid ID will be permitted entry. **NO HELPERS.**
 - 2) All personnel must sign in the Visitor's Book, to include the following information: **PERSON'S NAME, COMPANY NAME, REASON FOR ENTRY, WORK LOCATION IN BUILDING.**
 - 3) All personnel must conspicuously display the ID card and identify themselves upon request.
 - 4) If ID card is misplaced or lost, report this loss immediately to the Shift Captain or Associate Warden.
 - 5) All tradesmen will be required to perform a tool inventory inspection of all tools in their possession to demonstrate to the admitting Correction Officer that the typed inventory list matches the tools each time they enter and leave the building. The tradesmen are responsible for keeping all tools and equipment locked when not in immediate use and they must report any loss of tools or equipment immediately to the Shift Captain or Associate Warden.
 - 6) All tradesmen and helpers shall carry all tools in a locked and secured tool box or tool cart. A typed inventory sheet shall be carried with the tool box/cart listing all hand and power tools. A manufacturer's MSD Sheet shall be carried with the tool box/cart for any chemical compound that the tradesman has in his/her possession.
 - 7) All debris (i.e. packaging, demolition, etc) shall be removed from the worksite at the end of each workday.
 - 8) All personnel are subject to search at all times.
 - 9) All personnel must observe all orders of Correctional Staff.
 - 10) All personnel are to report any unusual incidents or problems to a Correction Officer, Shift Captain or the Associate Warden immediately.
 - 11) All personnel shall not possess or consume any alcoholic beverage or illegal drug or medication while on County property, or report to work under the influence of alcohol or drugs.
 - 12) Any vehicle left on County property must be locked and the ignition keys must be removed. Vehicles will not be left over-night on County property without prior approval.
 - 13) All personnel shall not enter any other areas of the prison (except the areas agreed to) without prior approval of the Shift Captain or the Associate Warden.

GENERAL REQUIREMENTS

- 14) All personnel shall not bring anything in for any inmate/detainee or staff member or take out anything for any inmate/detainee or staff member.
- 15) All personnel shall not engage in any unnecessary conversations with any inmate/detainee.
- 16) Weapons, i.e., guns, knives, blackjacks, to include any tool activated by gunpowder or other explosive charge is prohibited in the building (i.e., stud gun). Violators of this rule are subject to arrest.
- 17) All personnel must sign out when leaving and must return the ID card to the Control/Desk Officer before leaving.
- 18) Failure of the contractor to follow these procedures will result in the contractor being denied access to the facility.

5. PAYMENT FOR BONDS AND INSURANCE

The amount bid for contract bonds and insurance shall not exceed 3% of the total contract price excluding the bid price for Miscellaneous Additional Work (Item W800) and Field Testing Equipment (W851), where applicable. Should the bidder exceed the foregoing three percent (3%), the Department will make the necessary adjustment to determine the total amount bid based on the arithmetically correct proposal.

The amount bid shall be payable with the first contract payment.

6. ADDITIONAL INSURANCE REQUIREMENTS

1. The successful bidder shall submit with their bid, copies of the Insurance Policies in the types and amounts as stipulated above in the Information for Bidders Section "Insurance Requirements". In addition to the "claims made" insurance policies, the contractor shall maintain an Asbestos and Lead Abatement General Liability Occurrence Policy, in amounts not less than \$1,000,000 and naming owner as the certificate holder.

"The County of Westchester" must be included as an Additional Named Insured under all insurance policies associated with this project.

2. The hauler carrying asbestos and lead to the disposal site in addition to the types and amounts stipulated in the Information of Bidders section "Insurance Requirements", shall carry Pollution Liability Insurance covering Transit, Sudden & Accidental, and Clean-up in the amount not less than \$1,000,000.
Endorsements to existing policy will be acceptable

GENERAL REQUIREMENTS

CONTRACT DRAWINGS:

CONTRACT NUMBER 20-502

The Design Drawings, as listed on the Contract Drawing Index, herewith made a part of these Specifications, shows in general and/or in detail the work to be done under this Contract and/or the various Contracts forming the entire work for the Project, as described herein.

After sending the executed contract to the County and prior to the first job meeting, the Contractor is responsible for obtaining from Public Works, Division of Engineering, Michaelian Office Building, White Plains, a maximum of five gratis copies of the Contract Drawings and Specifications; for the Contractor's permanent possession. Additional sets, requested by the Contractor, beyond the permitted number and time limit, will be furnished by Public Works; but at the Contractor's expense.

<u>DRAWING NO.</u>	<u>TITLE</u>	<u>SHEET NO.</u>
52-11-T-1813-0	Title Sheet	T-001
52-11-G-1814-0	Drawing List	T-002
52-11-G-1815-0	Code Analysis	G-001
52-11-G-1816-0	Egress and Fire Rating Plan	G-002
52-11-G-1817-0	Phasing Plan – Phase I & II	G-003
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52-11-G-1826-0	Partial Demolition Reflection Ceiling Plan – 2 nd Floor North Wing	DM-008
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GENERAL REQUIREMENTS

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52-11-A-1842-0	Plumbing Plan & Fixture Schedule	A-120
52-11-A-1843-0	Power & Communication Plan – Restrooms	A-121
52-11-A-1844-0	Partial B3 Plan – Elevator Machine Rooms – 110 MLK Blvd	A-130
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52-11-A-1846-0	Partial Exterior Elevation – 110 MLK Blvd	A-132
52-11-A-1847-0	Partial 1 st Floor Plan – Judge Elevator – 111 MLK Blvd	A-133
52-11-A-1848-0	Roof Plan – Elevator Machine Room – 111 MLK Blvd	A-134
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GENERAL REQUIREMENTS

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Submit all proposal pages in this section, including all executed and unexecuted pages and fasten with a clip at the upper left hand corner.



George Latimer, Westchester County Executive

PROPOSAL PAGES

**LOW RISE BUILDING RENOVATIONS AND
HVAC IMPROVEMENTS - PHASE II
110 DR. MARTIN LUTHER KING, JR. BOULEVARD
WHITE PLAINS, NEW YORK**

Contract No. 20-502

Bid Opening: February 14, 2024

By Bidder (Please Print)	For Official Use Only
Firm/Business Name: _____	_____
Address: _____	_____
_____	_____

**DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION
Division of Engineering**

PROPOSAL REQUIREMENTS

BIDDER'S IDENTIFICATION

CONTRACT NO. _____

To the Commissioner of Public Works, Westchester County, New York, acting for the party of the first part.

Proposal made by _____
as party of the second part.

Whose business address is _____

Whose telephone number is _____

Whose E-mail address is _____

Whose Federal ID number is _____

Is bidder an individual,
a partnership or a corporation? _____

If a partnership or corporation,
give the names of all partners
or officers with their titles _____

If operating under a trade name or as partners, has the required Certificate been filed with a County Clerk in accordance with the General Business Law, Section 130?

Yes....[] No....[] N.A....[]

If the answer is NO, Certificate must be filed before the contract can be executed.

NOTE: the bid must be submitted using the Contractor's legal name, not just the "doing business as" (i.e. DBA) name.

COMPLETE THIS FORM USING BLACK INK ONLY

PROPOSAL REQUIREMENTS

1. The undersigned, the bidder, does hereby declare that it has carefully read the contract specifications and has carefully studied the relevant plans, profiles and other drawings (as defined in Article "Contract Drawings" of the General Requirements) relating to the contract work, and has inspected the site(s) of the work..
2. The undersigned does hereby declare that it is the only one interested in its indicated bid; that the bid is in all respects without fraud or reservations; and that no official of the County or of the participating municipalities (if any), or any person in the employ of the County of participating municipalities (if any) is directly interested in the contract bid or in the supplies, equipment or works to which it relates, or in any part of the profits resulting there-from.
3. The undersigned does hereby offer and agree to furnish all materials, to fully and faithfully construct, perform and execute all work under the contract in accordance with the plans, profiles, other drawings and specifications relating thereto, and to furnish all labor, tools, implements, machinery, forms, transportation and materials necessary and proper for said purpose at the following indicated lump sum price for the total work and/or the following indicated unit prices for the various items of the work.
4. The undersigned does hereby declare that the indicated price(s) cover all expenses of every kind incidental to the completion of the contract work, including all claims affecting the work, labor and materials, which may arise through any cause whatsoever, excepting as provided for in Article "Disputed Work-Notice Of Claims For Damages: of the General Clauses.
5. The undersigned hereby agrees that in the event that the quantities of contract work actually performed by the undersigned are less than the approximate quantities indicated in the specifications it will make no claim(s) for loss of anticipated profits.
6. The undersigned does hereby agree that it will execute a contract containing all the terms, conditions, provisions and covenants necessary to complete the work according to the appropriate plans and specifications, within ten working days after receipt by the undersigned of the contract from the County, and that if it fails to execute said contract within said period of time the County may rescind the contract award and may retain as liquidated damages and not as a penalty, any amounts submitted as the bid security accompanying the undersigned's proposal, and/or demand from the Bidder's Surety Company that executed the required Bid Bond and Consent of Surety to pay to the County the difference between the amount bid and the amount for which such contract is thereafter awarded, together with the cost to the County of reletting said contract up to the maximum aggregate amount of 25% of the amount bid.
7. The undersigned does hereby agree to commence the work encompassed under the contract within ten days after notification in writing from the Commissioner of Public Works or his authorized designee, unless a definite earlier or later start has been specified, and will complete the work fully and in every respect on or before the specified completion date; and further agrees that the County has the right to employ such combination of labor, equipment

PROPOSAL REQUIREMENTS

and materials as may be required for the proper completion of the contract work and to deduct all costs from such monies as may be due the undersigned, in the event the contract work is not completed by the specified completion date.

- 8. The undersigned does hereby agree to comply with all relevant provisions of the Labor Laws of the State of New York, and agrees to adhere to the provisions relating to the eight-hour day and five-day week, the payments of minimum rates for labor, and the latest laws relative to payments for wages for labor on public contracts.

- 9. The undersigned does hereby agree to insure all persons connected with the contract work against accident, at its own expense, as prescribed by the Workmen's Compensation Law of the State of New York; and that it will be responsible for payments by itself, its subcontractors and vendors of all taxes applicable to the work, and all other payments as may be required by various laws and rules and regulations of the Federal Government, the State of New York and its political subdivisions and agencies, such payments including but not limited to the following:
 - A. Federal Social Security Taxes on employees' wages.
 - B. Applicable Federal Excise Taxes.
 - C. New York State Unemployment Insurance and Disability Payments, based on employees' wages.

- 10. The undersigned does hereby agree to accept their indicated lump sum price for the total work and/or their indicated unit prices for the various items of the work as the sole basis in the determination of the value of addition to, or deletions from the specified scope of the contract work.

11. ADDENDUM RECEIPT - CONTRACT NO. _____

(The undersigned shall fill in contract number above, and the required information below.)

The undersigned does hereby acknowledge receipt of the below listed addenda to the contract specifications:

Addendum No. _____	Dated _____
Addendum No. _____	Dated _____
Addendum No. _____	Dated _____
Addendum No. _____	Dated _____
Addendum No. _____	Dated _____

COMPLETE THIS FORM USING BLACK ONLY

PROPOSAL REQUIREMENTS

12. Bidders should not submit the entire Bid document with its bid submission. Instead, Bidders must submit ALL of the Proposal Pages. Proposal Pages are denoted by a border and are titled on the bottom as "Proposal Page ___".

Be sure that, where required, the forms have been completed and signed by a notary public.

Proposal Page 12 must be completed by a surety company and submitted with the bid if a Performance and Payment Bond is required in accordance with the "Notice to Contractors".

13. NON-COLLUSIVE BIDDING CERTIFICATION

Made pursuant to Section 103-d of the General Municipal Law of the State of New York as amended by the Laws of 1966.

- A. By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of his knowledge and belief:
- 1) The prices in this bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor;
 - 2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor; and
 - 3) No attempt has been made or will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.
- B. A bid shall not be considered for award nor shall any award be made where a. (1), (2) and (3), above, have not been complied with; provided however, that if any case the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the bid a signed statement which sets forth in detail the reasons therefore. Where a. (1), (2) and (3), above, have not been complied with, the bid shall not be considered for award nor shall any award be made unless the head of the purchasing unit of the political subdivision, public department, agency or official thereof to which the bid is made, or his designee, determines that such disclosure was not added for the purpose of restricting competition."
14. The undersigned and each person signing in behalf of the undersigned hereby executes the foregoing Affirmative Action Questionnaire, Proposal, Addendum Receipt and Non-Collusive Bidding Certification.
15. The undersigned and each person signing on behalf of the undersigned hereby certifies that

PROPOSAL REQUIREMENTS

the person, firm or corporation submitting this proposal as the bidder has not been found guilty of a willful violation of the New York State Labor Law for failure to pay prevailing wages and supplements, as those terms are defined by the New York State Labor Law, within the twelve (12) months immediately preceding the submission of this bid.

16. The undersigned, by submitting the Proposal Pages, acknowledges that it has read the complete bid package including any and all addenda thereto and its bid includes all of the terms and conditions set forth in the bid documents, including, but not limited to, the Notice to Contractors, General Requirements and Proposals, Contract plans/drawings (if any), Proposal Forms, Information for Bidders, General Clauses, Sample Forms and Attachments, Sample Contract and Bond, Schedule of Hourly Rates and Supplements, Technical Specifications, any Special Notices and all applicable laws, rules and regulations. The undersigned further acknowledges that by submitting this bid the above denoted items are incorporated by reference and constitute an integral part of its bid.
17. The undersigned agrees that, if it is not the Successful bidder, the Sealed List of Subcontractors submitted with its bid can be destroyed by the County. **Please check the following box if you want the Sealed List of Subcontractors returned to you.**

Dated _____, 20__

Legal Name of Person, Firm or Corporation

(Seal of Corporation)

Business Address of Person, Firm or Corporation

By _____
Signature

Title

COMPLETE THIS FORM USING BLACK INK ONLY

ITEMIZED PROPOSAL

ITEM NO.	DESCRIPTION	AMOUNT BID	
		DOLLARS	CENTS
A	For providing all labor, material and equipment necessary to complete all work as shown on the contract drawings and in accordance with the specifications for the Low Rise Building Renovations and HVAC Improvements – Phase II, 110 Dr. Martin Luther King, JR. Boulevard, White Plains, New York	\$	
B	Contract Bonds and Insurance (Must not exceed 3.00% of Subtotal shown above)	\$	
C	Necessary for Miscellaneous Additional Work per Article “Miscellaneous Additional Work (Item W-800)” of Information for Bidders, as directed	\$ 900,000	00
D	Testing of Materials and Field Testing Equipment (Item W-851)	\$ 100,000	00
TOTAL SUM OF AMOUNT BID FOR BASE BID ITEMS A, B, C & D (WRITTEN IN FIGURES)		\$	

CONTRACTOR: _____

ADDRESS: _____

BY: _____

Signature/Title

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR'S ACKNOWLEDGMENT

(If Corporate)

STATE OF NEW YORK)
COUNTY OF WESTCHESTER) ss.:

On this _____ day of _____, 20____, before me personally came _____
_____ to me known and known to me to be the _____
_____ of _____ the corporation described in and which
executed the within instrument, who being by me duly sworn did depose and say that he the said_
_____ resides at _____
_____ and that he is _____ of said corporation and knows the corporate
seal of the said corporation; that the seal affixed to the within instrument is such corporate seal and
that it was so affixed by order of the Board of Directors of said corporation, and that he signed his
name thereto by like order.

Notary Public

CONTRACTOR'S ACKNOWLEDGMENT

(If Individual)

STATE OF NEW YORK)
COUNTY OF WESTCHESTER) ss.:

On this _____ day of _____, 20____, before me personally came _____
_____ to me known, and known to me to be the same person described in
and who executed the within instrument and he duly acknowledged to me that he executed the same
for the purpose herein mentioned and, if operating under the trade name, that the certificate required
by the New York State General Business Law Section 130 has been filed with the County Clerk of
Westchester County.

Notary Public

CONTRACTOR'S ACKNOWLEDGMENT

(If Co-Partnership)

STATE OF NEW YORK)
COUNTY OF WESTCHESTER) ss.:

On this _____ day of _____, 20____, before me personally came _____
_____ to me known, and known to me to be a member of the firm of
_____ and the person described in, and who executed the
within instrument in behalf of said firm, and he acknowledged to me that he executed the same in
behalf of, and as the act of said firm for the purposes herein mentioned and that the certificate
required by the New York State General Business Law Section 130 has been filed with the County
Clerk of Westchester County.

Notary Public

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF AUTHORITY

I, _____
(Officer other than officer executing proposed documents)

certify that I am _____ of the
(Title)

(Name of Contractor)

(the "Contractor"), a corporation duly organized and in good standing under the

(Law under which organized, e.g., the New York Business Corporation Law)

named in the foregoing agreement; that _____
(Person executing proposal documents)

who signed said agreement on behalf of the Contractor was, at the time of execution the

_____ of the Contractor; that said agreement was
(Title of such person)

duly signed for and in behalf of said Contractor by authority of its Board of Directors, thereunto
duly organized, and that such authority is in full force and effect at the date hereof.

(Signature)

(SEAL)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this _____ day of, _____, 20____, before me personally came
_____ to me known, and known to me to be
the _____ of _____, the
Corporation described in and which executed the above certificate, who being by me duly sworn did
depose and say that he, the said _____ resides at
_____ and that he is _____
_____ of said Corporation and knows the Corporate Seal of the said
Corporation; that the seal affixed to the above certificate is such Corporate Seal and that it was so
affixed by order of the Board of Directors of said Corporation, and that he signed his name thereto
by like order.

Notary Public

COMPLETE THIS FORM IN BLACK INK ONLY

***Required for all Bids over \$100,000 where a Performance & Payment Bond
is Required in accordance with the "Notice to Contractors"***

CONTRACT NO. _____

BID BOND AND CONSENT OF SURETY

KNOW ALL PERSONS BY THESE PRESENTS, That _____
(Name of Contractor)

(Address)

(hereinafter called the "Principal") and the _____ a
corporation created and existing under the laws of the State of _____, having its principal office
at _____ (hereinafter called the "Surety"),

(PRINT FULL ADDRESS OF SURETY)

are held and firmly bound unto the County of Westchester (hereinafter called the "Obligee"), in the full just
sum of *Twenty-Five (25%) Percent of the Attached Bid*, good and lawful money of the United States of
America, for the payment of which said sum of money, well and truly to be made and done, the said
Principal binds themselves (himself/herself, itself), their (his/her, its) heirs, executors and administrators,
successors and assigns, and the said Surety binds itself, its successors and assigns jointly and severally,
firmly by these presents:

WHEREAS, the said Principal has submitted to the County of Westchester, New York, a
proposal/bid for Contract Number: _____
Project Title: _____ and

WHEREAS, under the terms of the Laws of the State of New York as above indicated, the said
Principal has filed or intends to file this bond to guarantee that the Principal will execute all required contract
documents, furnish all required insurance and furnish such Performance and Payment Bonds or other bonds
as may be required in accordance with the terms of the Principal's said proposal/bid.

NOW, THEREFORE, the Surety agrees:

(i) if the Contract for which the preceding estimate and proposal is made, is awarded to the Bidder by
the County, the Surety shall become bound as Surety and guarantor for the faithful performance of the
Contract and shall execute and deliver a Performance & Payment Bond, in a form acceptable to the County,
in the amount of 100% of the total Contract price, or such other amount as may be specified in the Bid
documents, and shall execute the Contract as party of the third part when required to do so by the Board of
Acquisition and Contract of the County; and

(ii) if the Bidder shall, upon award of the Contract to the Bidder, fail or refuse to execute the Contract
and furnish the necessary bonds and insurance certificates, the Surety shall, on demand by the County, pay to
the County the difference between the amount bid and the amount for which such contract is thereafter
awarded, together with the cost to the County of reletting said Contract, up to the maximum aggregate
amount of this bond.

(iii) the condition of the foregoing obligation is such, that if the said Principal shall promptly execute
and submit, and the County shall accept, all required contract documents including insurance and such
Performance and Payment Bond or other bonds, all as may be required in accordance with the terms of the
Principal's said bid/proposal, then this obligation shall be null and void, otherwise to remain in full force and
virtue.

The Surety, for value received, the receipt of which is hereby acknowledged by the Surety, hereby stipulates and agrees that the obligation of the Surety and of its bond shall remain absolute and shall be in no way impaired, affected or discharged by an extension of time, mutually agreed to by the County and the Bidder, within which the County may award said Contract, and the Surety hereby waives notice of any such extension.

IN TESTIMONY WHEREOF, the said Principal has hereunto set his/her (their, its) hand and the said Surety has caused this instrument to be signed by its duly authorized officer this _____ day of _____ 200__.

Signed and delivered this ____ day of _____ 20____ in the presence of:

(Print Name of Contractor)

_____ Principal
(Signature)

(Title of Authorized Officer)

(Print Name of Surety)

By _____ Surety
(Signature)

(Title of Authorized Officer)

(The Surety Company shall append a single copy of a statement of its financial condition, a copy of the resolution authorizing the execution of Bonds by officers of the Surety Company, Power of Attorney, Surety Acknowledgment.)

AFFIRMATIVE ACTION PROGRAM REQUIREMENT

Affirmative Action Program

An approved Affirmative Action Plan shall be required in all contracts for public work where the awarded contract amount exceeds \$50,000 or more than fourteen (14) persons are employed by the Contractor and/or his subcontractors.

Does the Contractor participate in an approved Affirmative Action Program? Yes [] No []

If Yes, give name of Program: _____

If No, how many employees (total) does the Contractor employ. Please also include in your count the number of employees the Contractor and its Subcontractors expect to use on this project: _____

An approved Affirmative Action Program shall mean a plan approved or adopted by Westchester County including but not limited to, the Home-Town Plan, the Recruitment Training Program or any other program approved or meeting the requirements of the State or Federal government.

The “Monthly Employment Utilization Report” of the Sample Forms, shall be filled out by the Contractor and/or Subcontractor(s) who are required to have an Affirmative Action Program, prior to the start of the work.

Before any subcontractor is approved for use on this contract it will have to complete and submit the “Affirmative Action Program Requirement- Subcontractors” form of the Sample Forms.

COMPLETE THIS FORM USING BLACK INK ONLY

APPRENTICESHIP TRAINING PROGRAM REQUIREMENT

Apprenticeship Training Program

An approved Apprenticeship Training Program shall be required in all contracts for public work where the awarded contract amount exceeds \$50,000. and more than fourteen (14) persons are employed by the Contractor or Subcontractor(s).

Will the Contractor utilize apprentices for this Contract? Yes [] No []

If Contractor Yes, do the apprentices participate in an approved Apprenticeship Training Program? Yes [] No []

If Contractor Yes, give the name of the Program: _____

Will the Subcontractor(s) utilize apprentices for this Contract? Yes [] No []

If Subcontractor(s) Yes, do the apprentices participate in an approved Apprenticeship Training Program? Yes [] No []

If Subcontractor(s) Yes, give the name of the Program: _____

AN APPROVED APPRENTICESHIP TRAINING PROGRAM SHALL MEAN A NEW YORK STATE REGISTERED APPRENTICESHIP TRAINING PROGRAM AS DEFINED UNDER THE NEW YORK STATE LABOR LAW.

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF LICENSE

(TO BE COMPLETED BY AN ELECTRICAL BIDDER ONLY)

_____, being duly sworn
(Name)

deposes and says that the following statements are true:

(1) I am the _____ of the
(Title)

_____, the bidder named on the
(Name of Contractor)

bid proposal, and I have read and am familiar with: a) the electrical license requirements contained in the Information for Bidders of the bid, b) Chapter 277 Article XVII of the Laws of Westchester County entitled Electrical Licensing Board and the Licensing of Master Electricians, and c) the Westchester County Electrical Licensing Board Rules and Regulations.

(2) I am familiar with, and this bid is being submitted in compliance with, the Westchester County Electrical Licensing Board Rules and Regulations, in particular No. 11, which states as follows:

No individual holding a Master Electrician’s License shall lend such License to any person or allow any other person to carry on, engage in, or labor at the business as defined herein of installing, removing, altering, testing, replacing, or repairing electrical systems. A violation of this section by any person holding a License shall be sufficient cause for revocation of such License.

However, nothing herein shall be construed to prohibit the use of a License by the holder thereof for or on behalf of a partnership, corporation or other business association, provided that fifty-one (51) percent or more of the control of the voting capital stock of such partnership, corporation, or other business association is owned by one (1) or more holders of a Westchester County Master Electrical License and that all work performed by such partnership, corporation or other business association is performed by or under the direct supervision of such License holder or holders.

(3) That, as of this date, the bidder submitting the bid possesses the applicable valid Master/”Special” Electrician’s license issued by the Westchester County Electrical Licensing Board; that this License is being used in compliance with the Laws of Westchester County and Westchester County Electrical Licensing Board Rules and Regulations; and **I have provided a copy of such license with the sealed bid proposal.**

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF LICENSE (Continued)

(TO BE COMPLETED BY AN ELECTRICAL BIDDER ONLY)

(4) That all electrical work shall be performed in accordance with the requirements of Chapter 277 Article XVII of the Laws of Westchester County entitled Electrical Licensing Board and the Licensing of Master Electricians and the Westchester County Electrical Licensing Board Rules and Regulations.

(5) That I make this statement in connection with the submission of the bid as proof of the required electrical license, knowing that this statement will be relied upon by the County in the evaluation of that bid.

Signature

Sworn to before me
this _____ day of _____

License No.

Notary Public - State of New York

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF LICENSE

(TO BE COMPLETED BY A PLUMBING BIDDER ONLY)

_____, being duly sworn
(Name)

deposes and says that the following statements are true:

(1) I am the _____ of the
(Title)

_____, the bidder named on the
(Name of Contractor)

bid proposal, and I have read and am familiar with: a) the plumbing license requirements contained in the Information for Bidders of the bid, b) Chapter 277 Article XV of the Laws of Westchester County entitled Westchester County Board of Plumbing Examiners and County-wide Plumbing License, and c) the Westchester County Board of Plumbing Examiners Rules and Regulations.

(2) I am familiar with, and this bid is being submitted in compliance with, Section 277.509A of Article XV of Chapter 277 of the Laws of Westchester County, which states as follows:

A. No holder of a license or certification issued under this article shall authorize, consent to or permit the use of his or her license or certification by or on behalf of any other person. No person who has not qualified or obtained a license or certification under this article shall represent himself or herself to the public as holder of a license or certification issued under this article, either directly, by means of signs, sign cards metal plates or stationery, or indirectly in any other manner whatsoever. However, nothing herein shall be construed to prohibit the use of a license by the holder thereof for or on behalf of a partnership, corporation or other business association, provided that 51 percent or more of the control of the voting capital stock of such partnership, corporation or other business association is owned by one or more holders of a Westchester County master plumbing license and that all work performed by such partnership, corporation or other business association is performed by or under the direct supervision of such license holder or holders.

(3) That, as of this date, the bidder submitting the bid possesses a valid Master Plumber's license issued by the Westchester County Board of Plumbing Examiners; that this License is being used in compliance with the Laws of Westchester County and the Westchester County Board of Plumbing Examiners Rules and Regulations; and **I have provided a copy of such license with the sealed bid proposal.**

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF LICENSE (Continued)

(TO BE COMPLETED BY A PLUMBING BIDDER ONLY)

(4) That all plumbing work shall be performed in accordance with the requirements of Chapter 277, Article XV of the Laws of Westchester County entitled Westchester County Board of Plumbing Examiners and County-wide Plumbing License, and the Westchester County Board of Plumbing Examiners Rules and Regulations.

(5) That I make this statement in connection with the submission of the bid as proof of the required plumbing license, knowing that this statement will be relied upon by the County in the evaluation of that bid.

Signature

Sworn to before me
this _____ day of _____

License No.

Notary Public - State of New York

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF LICENSE

(TO BE COMPLETED BY A HAULING BIDDER OR SUBCONTRACTOR ONLY)

_____, being duly sworn
(Name)

deposes and says that the following statements are true:

(1) I am the _____ of the
(Title)

_____, the bidder/subcontractor (circle one)
(Name of Contractor)

named on the foregoing bid proposal, and I have read and am familiar with the hauling license requirements contained in the Information for Bidders of the foregoing bid.

(2) That, as of this date, the bidder submitting the foregoing bid/subcontractor of the bidder submitting the foregoing bid (circle one) possesses a valid _____ license
(License type, i.e. Class "A")
issued by the Westchester County Solid Waste Commission.

(3) That all hauling work shall be performed in accordance with the requirements of Chapter 826-a of the Laws of Westchester County.

(4) That I make this statement in connection with the submission of the foregoing bid as proof of the required hauling license, knowing that this statement will be relied upon by the County in the evaluation of that bid.

Signature

Sworn to before me
this _____ day of _____

License No.

Notary Public - State of New York

COMPLETE THIS FORM USING BLACK INK ONLY

STORMWATER POLLUTION PREVENTION CERTIFICATION

I certify under penalty of law that I understand and agree to comply with the terms and conditions of the Stormwater Pollution Prevention Plan (“SPPP”) for the construction site identified in such SPPP as a condition of authorization to discharge stormwater. I also understand the operator must comply with the terms and conditions of the New York State Pollutant Discharge Elimination System (“SPDES”) general permit for stormwater discharges from construction activities and it is unlawful for any person to contribute to a violation of water quality standards.

Signature

Sworn to before me

This _____ day of _____, 200_.

Notary Public – State of New York, County of _____

My Commission Expires on _____.

This Certification will also have to be signed by your subcontractors. Additional copies of this form can be acquired from the Department of Public Works.

COMPLETE THIS FORM USING BLACK INK ONLY

PREVAILING WAGE RATES AND SUPPLEMENTS

Compliance with the New York State Construction (Article 1, Section 17) and the New York State Labor Law (Section 220)

Is your firm in full compliance with the New York State Labor Law?
(Please check one)

Yes _____ No _____

Are the wage supplements paid into a Federally approved program?
(Please check one)

Yes _____ No _____

If Yes, please indicate which program:

If No, please indicate how the supplements are being paid:

Yes, I have read and understand the terms of this Contract and the laws of this Agreement:

Signature

Date: _____

Notary Public

Date: _____

COMPLETE THIS FORM USING BLACK INK ONLY

MINORITY/WOMEN BUSINESS ENTERPRISE PROGRAM QUESTIONNAIRE
QUESTIONNAIRE REGARDING BUSINESS ENTERPRISES
OWNED AND CONTROLLED BY WOMEN OR PERSONS OF COLOR

As part of the County's program to encourage the meaningful and significant participation of business enterprises owned and controlled by persons of color or women in County contracts, and in furtherance of Section 308.01 of the Laws of Westchester County, completion of this form is required.

A "business enterprise owned and controlled by women or persons of color" means a business enterprise, including a sole proprietorship, limited liability partnership, partnership, limited liability corporation, or corporation, that either:

- 1.) meets the following requirements:
 - a. is at least 51% owned by one or more persons of color or women;
 - b. is an enterprise in which such ownership by persons of color or women is real, substantial and continuing;
 - c. is an enterprise in which such ownership interest by persons of color or women has and exercises the authority to control and operate, independently, the day-to-day business decisions of the enterprise; and
 - d. is an enterprise authorized to do business in this state which is independently owned and operated.

- 2.) is a business enterprise certified as a minority business enterprise ("MBE") or women business enterprise ("WBE") pursuant to Article 15-a of the New York State Executive Law and the implementing regulations, 9 New York Code of Rules and Regulations subtitle N Part 540 et seq., **OR**

- 3.) is a business enterprise certified as a small disadvantaged business concern pursuant to the Small Business Act, 15 U.S.C. 631 et seq., and the relevant provisions of the Code of Federal Regulations as amended.

Please note that the term "persons of color," as used in this form, means a United States citizen or permanent resident alien who is and can demonstrate membership of one of the following groups:

- (a) Black persons having origins in any of the Black African racial groups;
- (b) Hispanic persons of Mexican, Puerto Rican, Dominican, Cuban, Central or South American descent of either Indian or Hispanic origin regardless of race;
- (c) Native American or Alaskan native persons having origins in any of the original peoples of North America; or
- (d) Asian or Pacific Islander persons having origins in any of the Far East countries, South East Asia, the Indian subcontinent or the Pacific Islands.

1. Are you a business enterprise owned and controlled by women or persons of color in accordance with the standards listed above?

_____ No

_____ Yes

Please note: If you answered “yes” based upon certification by New York State and/or the Federal government, official documentation of the certification must be attached.

2. If you answered “Yes” above, please check off below whether your business enterprise is owned and controlled by women, persons of color, or both.

_____ Women

_____ Persons of Color (*please check off below all that apply*)

_____ Black persons having origins in any of the Black African racial groups

_____ Hispanic persons of Mexican, Puerto Rican, Dominican, Cuban, Central or South American descent of either Indian or Hispanic origin regardless of race

_____ Native American or Alaskan native persons having origins in any of the original peoples of North America

_____ Asian or Pacific Islander persons having origins in any of the Far East countries, South East Asia, the Indian sub-continent or the Pacific Islands

Name of Business Enterprise: _____

Address: _____

Name and Title of person completing questionnaire: _____

Signature: _____

Notary Public

Date

CONTRACTOR'S DISCLOSURE STATEMENT

Instructions:

The County of Westchester, in order to insure that it employs responsible contractors for its major construction projects, requires all bidders for construction contracts (which includes reconstruction and repair) with an estimated value of One Hundred Thousand (\$100,000.00) or more Dollars to answer completely and swear to the questions below. If a Contractor Disclosure Statement has been included with this bid specification, then the County has determined that it is applicable to this bid. All subcontractors whose contract has a value of One Hundred Thousand (\$100,000.00) or more Dollars must also submit a Contractor Disclosure Statement.

Please read the questions carefully and answer them completely. Before you answer these questions, please read the definitions of terms used in these questions. While you may contact the Department of Public Works if you have questions about this form, the County cannot provide you with any legal advice for which you must contact your own lawyer. **FAILURE TO COMPLETE THIS CONTRACTOR DISCLOSURE STATEMENT IN GOOD FAITH MAY RESULT IN THE REJECTION OF YOUR BID.**

If you have previously filled out a Contractor Disclosure Statement for another County bid and only some but not all of your responses have changed, attach a copy of the prior Contractor Disclosure Statement and check #2 below indicating changes only and only answer those questions which have changed since you last filled out the Contractor Disclosure Statement.

If you have previously completed a Contractor Disclosure Statement for another County bid and nothing has changed in your responses to the questions, then check #3 and fill out the attached No Change Affidavit. Attach a copy of the prior Contractor Disclosure Statement to the No Change Affidavit.

NOTE IF THE SPACES PROVIDED FOR ANSWERS ARE NOT SUFFICIENT FOR YOU TO COMPLETE YOUR ANSWER TO A PARTICULAR QUESTION, THEN ATTACH ADDITIONAL PAGES TO THIS CONTRACTOR DISCLOSURE STATEMENT WHICH INDICATE THE NUMBER OF THE QUESTION THAT YOU ARE COMPLETING THE ANSWER FOR.

ALSO DO NOT LEAVE ANY ANSWERS BLANK. IF A QUESTION IS NOT APPLICABLE, ANSWER - N/A – AND OFFER A BRIEF EXPLANATION AS TO WHY THE QUESTION DOES NOT APPLY.

Definitions:

Affiliate – is another Business Entity in which the Contractor or one or more of the Principals of the Contractor has an ownership interest of more than fifty (50%) percent. An Affiliate is also another Business Entity in which the Parent of the Contractor owns more than fifty (50%) percent of that other Business Entity.

Agency or Government Agency – is any Federal, State, City or other local agency including, but not limited to, departments, offices, quasi-public agencies, public authorities and

CONTRACTOR'S DISCLOSURE STATEMENT

corporations, boards of education and higher education, public development corporations and local development corporations.

Assignee – is a person or Business Entity to whom an assignment (e.g., a transfer to another of any property, real or personal, including a transfer of any rights in such property) is made.

Business Address – is the location of principal executive offices and is also the primary place of business in Westchester County, if different.

Business Entity – is any profit-seeking business including, but not limited to, corporations, limited and general partnerships, joint ventures and individual (sole) proprietorships.

Contract – is any binding agreement with any Government Agency or other Business Entity for the provision of goods, or services including, but not limited to, construction.

Contractor – is the Business Entity submitting this Contractor Disclosure Statement.

Contractor Disclosure Statement – is this document.

Control – A Business Entity controls another Business Entity when:

- The controlling Business Entity owns more than fifty (50%) percent of the controlled Business Entity, or
- The controlling Business Entity directs or has the right to direct daily operations of the controlled Business Entity, or
- The same person is a Principal in both businesses and directs the daily operations of the controlled Business Entity.

Investigations – is any official inquiry by any Government Agency, with the exception of background investigations for employment.

Officer – is any individual who serves in the function of chief executive officer, chief financial officer or chief operating officer of the Business Entity by whatever titles known.

Parent – is a Business Entity which owns more than fifty (50%) percent of another Business Entity.

Principal – is an individual, partnership, joint venture or corporation which holds ten (10%) percent or more ownership interest in the Business Entity.

Partner – shall mean a person or Business Entity that has a joint ownership in a particular business, but the ownership interest is not as a shareholder of a corporation.

Successor – is a person or Business Entity that takes the place that another has left. With reference to a corporation, a successor shall mean another corporation which, through amalgamation, consolidation, or other legal succession, becomes invested with the rights and assumes the burdens of the first corporation.

CONTRACTOR'S DISCLOSURE STATEMENT

CONTRACT NO.: _____

Check if Subcontractor

Type Of Submission

(Put a X or √ next to the applicable type of submission)

1. **Fully Completed Contractor Disclosure Statement** _____
(Sign Oath on last page of Disclosure Statement)

2. **Changes Only Contractor Disclosure Statement** _____
(Attach copy of previously filed Contractor Disclosure Statement that you are amending. Denote any changes on the following Contractor Disclosure Statement. Sign Oath on last page of this Disclosure Statement)

3. **No Change** _____
(Fill out "No Change Affidavit" [below] and attach copy of previously filed Contractor Disclosure Statement)

NO CHANGE AFFIDAVIT

I swear that the attached Contractor Disclosure Statement was submitted to the County of Westchester on _____ and was true as signed, and that
(Date)
since the above date nothing has occurred which changes in any way the responses made to the questions contained in the attached Contractor Disclosure Statement.

Submitted by: _____
(Signature)

Name (Print): _____

Title (Print): _____

Sworn to before me this ____ day of _____, 200_

NOTARY PUBLIC

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR'S DISCLOSURE STATEMENT

Questions:

1. The Business Address and taxpayer identification number of Contractor and primary telephone number for such location.

2. List the Business Addresses and primary telephone numbers for such locations, if different from answer to #1 above, where Contractor has been located over the last five (5) years.

3. List all other names and taxpayer identification numbers under which the Contractor, or the Principals and Officers of Contractor, have conducted business within the prior five (5) years.

4. For any response to #3 above, list any and all Westchester County contracts that were awarded to such "other name" Business Entity.

5. List the type of Business Entity that the Contractor is presently organized as (for example - sole proprietorship, partnership, joint venture or corporation).

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR'S DISCLOSURE STATEMENT

6. If Contractor is a corporation, list the date that the Contractor was incorporated. Also list the name of the Government Agency and location of said Agency in which a certificate of incorporation, certificate of doing business or equivalent, has been filed and the date of any amendments thereto. If, however, the Contractor is a partnership, list the date that the partnership was formed and the name of the Government Agency and location of said Agency in which a business certificate for partnership or equivalent has been filed.

7. List all the names, current Business Addresses and business telephone numbers of the Principals and Officers of the Contractor. If the Contractor is a partnership, list all partners and their business telephone numbers.

8. List the names, current Business Addresses, telephone numbers and taxpayer identification numbers of all Affiliates of the Contractor.

9. List all the names, Business Addresses and telephone numbers of the Principals and Officers of the Affiliates listed in response to #7 above. If the Affiliate is a partnership, list the Business Addresses and business telephone numbers of all partners.

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR'S DISCLOSURE STATEMENT

10. Is the Contractor Controlled by another Business Entity? ____ Yes ____ No. If you answered yes, please identify the name, Business Address and telephone number of that Controlling Business Entity and list any contracts that the Controlling Business Entity has had with Westchester County in the past five (5) years?

11. If the Contractor has Control of any other Business Entity that has had a Contract with the County of Westchester in the past five (5) years, please identify the name, Business Address and telephone number of that Controlled Business Entity.

12. List any and all contract sanctions imposed on the Contractor or on a Business Entity listed in response to #3 above that was imposed by a Government Agency during the prior five (5) years, including, but not limited to, all cautions, suspensions, debarments, cancellations of a contract based on business conduct, declarations of default, determinations of ineligibility to bid or whether any proceedings to determine eligibility to bid are pending.

13. List the contract sanction history for the past five (5) years, as defined in #12 above, for any Affiliate of the Contractor.

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR'S DISCLOSURE STATEMENT

14. If you answered yes to #10 above, list the contract sanction history as defined in #12 above for the Controlling Business Entity during the past five (5) years.

15. List any and all prevailing wage or supplement payment violations; state labor law violations deemed willful and any other federal or state citations, notices, violation orders, pending administrative hearings or proceedings or determinations of a violation of any labor law or regulation regarding the Contractor.

16. List all Investigations of the Contractor, its Principals and Officers or, if a partnership, of the Contractor's Partners. Also list all investigations of Affiliates, their Principals and Officers or, if a partnership, of their Partners.

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR'S DISCLOSURE STATEMENT

17. Have all Federal and State income tax returns, if required, been filed by Contractor during the last five (5) years? ___Yes ___No If you answered no, please explain why such returns were not filed.

18. Are there any criminal proceedings pending against the Contractor or any Principal or Officer of the Contractor or partner, if Contractor is a partnership? ___Yes ___No If you answered yes, please provide details of the pending criminal proceedings.

19. List the record of all criminal convictions of the Contractor, any Principal or Officer or partner, if Contractor is a partnership, and of any former Principal or Officer, of the Contractor or former partner, if Contractor is a partnership, for any crime related to truthfulness or business conduct and for any felony committed within the prior ten (10) years.

20. List all bankruptcy proceedings that the Contractor or its Affiliates have been the subject of within the past seven (7) years, whether pending or completed.

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR'S DISCLOSURE STATEMENT

21. Is the Contractor a successor, assignee or Affiliate of a Business Entity that has ever been denied a Contract or deemed ineligible to bid on a Government Agency contract?

___ Yes No ___ If you answered yes, explain below.

OATH

I swear that all of the above answers are true based on my knowledge of the facts, or are believed by me to be true, based upon a review of records containing the facts or based upon information I obtained from someone who has knowledge of the facts; and that I have authority to sign this document; and that the answers given above have not been made in a manner intended to deceive or to defeat the purpose of the Contractor Disclosure Statement, which is to assist the County of Westchester in determining if the Contractor is a responsible bidder.

Submitted by: _____
(Signature)

Name (Print): _____

Title (Print): _____

Sworn to before me this ___ day of _____, 20__

NOTARY PUBLIC

COMPLETE THIS FORM USING BLACK INK ONLY

REQUIRED DISCLOSURE OF RELATIONSHIPS TO COUNTY

(Prior to execution of a contract by the County, a potential County contractor must complete, sign and return this form to the County)

Contract Name and/or ID No.:

(To be filled in by County)

Name of Contractor:

(To be filled in by Contractor)

A potential County contractor must complete this form as part of the proposed County contract.

- 1.) Are any of the employees that the Contractor will use to carry out this contract also a County officer or employee, or the spouse, child, or dependent of a County officer or employee?

Yes _____ No _____

If yes, please provide details (attach extra pages, if necessary): _____

- 2.) Are any of the owners of the Contractor or their spouses a County officer or employee?

Yes _____ No _____

If yes, please provide details (attach extra pages, if necessary): _____

- 3.) Do any County officers or employees have an **interest**¹ in the Contractor or in any approved subcontractor that will be used for this contract?

Yes _____ No _____

If yes, please provide details (attach extra pages, if necessary): _____

By signing below, I hereby certify that I am authorized to complete this form for the Contractor.

Name: _____

Title: _____

Date: _____

¹ "Interest" means a direct or indirect pecuniary or material benefit accruing to a County officer or employee, his/her spouse, child or dependent, whether as the result of a contract with the County or otherwise. For the purpose of this form, a County officer or employee shall be deemed to have an "interest" in the contract of:

- 1.) His/her spouse, children and dependents, except a contract of employment with the County;
- 2.) A firm, partnership or association of which such officer or employee is a member or employee;
- 3.) A corporation of which such officer or employee is an officer, director or employee; and
- 4.) A corporation of which more than five (5) percent of the outstanding capital stock is owned by any of the aforesaid parties.

QUESTIONNAIRE REGARDING BUSINESS ENTERPRISES
OWNED AND CONTROLLED BY
SERVICE-DISABLED VETERANS

The County believes it is a laudable goal to provide business opportunities to veterans who were disabled while serving our country, and wants to encourage the participation in County contracts of certified business enterprises owned and controlled by service-disabled veterans. As part of the County's program to encourage the participation of such business enterprises in County contracts, and in furtherance of Article 17-B of the New York State Executive Law, we request that you answer the questions listed below.

The term "Certified Service-Disabled Veteran-Owned Business" shall mean a business that is a certified service-disabled veteran-owned business enterprise under the New York State Service-Disabled Veteran-Owned Business Act (Article 17-B of the Executive Law).

1. Are you a business enterprise that is owned and controlled by a service-disabled veteran in accordance with the standards listed above?

_____ No
_____ Yes

2. Are you certified with the State of New York as a Certified Service-Disabled Veteran-Owned Business?

_____ No
_____ Yes

3. If you are certified with the State of New York as a Certified Service-Disabled Veteran-Owned Business, please attach a copy of the certification.

Name of Firm/Business Enterprise: _____

Address: _____

Name/Title of Person completing Questionnaire: _____

Signature: _____

STATE OF NEW YORK)
) ss.:
COUNTY OF)

Notary Public

Date:

SCHEDULE "F"
CRIMINAL BACKGROUND DISCLOSURE
INSTRUCTIONS

Pursuant to Executive Order 1-2008, the County is required to maintain a record of criminal background disclosure from all persons providing work or services in connection with any County contract, including leases of County-owned real property and licenses:

- a.) If any of the persons providing work or services to the County in relation to a County contract are not subject to constant monitoring by County staff while performing tasks and/or while such persons are present on County property pursuant to the County contract; and
- b.) If any of the persons providing work or services to the County in relation to a County contract may, in the course of providing those services, have access to sensitive data (for example SSNs and other personal/secure data); facilities (secure facilities and/or communication equipment); and/or vulnerable populations (for example, children, seniors, and the infirm).

In those situations, the persons who must provide a criminal background disclosure ("Persons Subject to Disclosure") include the following:

- a.) Consultants, Contractors, Licensees, Lessees of County-owned real property, their principals, agents, employees, volunteers or any other person acting on behalf of said Contractor, Consultant, Licensee, or Lessee who is at least sixteen (16) years old, including but not limited to Subconsultants, subcontractors, Sublessess, or Sublicensees who are providing services to the County, and
- b.) Any family member or other person, who is at least sixteen (16) years old, residing in the household of a County employee who lives in housing provided by the County located on County property.

Under Executive Order 1-2008, it is the duty of every County Consultant, Contractor, Licensee, or Lessee to inquire of each and every Person Subject to Disclosure and disclose whether they have been convicted of a crime or whether they are subject to pending criminal charges, and to submit this form with that information.¹ Accordingly, you are required to complete the attached Criminal Background Disclosure Form and Certification.

Please note that under no circumstances shall the existence of a language barrier serve as a basis for the waiver of or an exception from the disclosure requirements of Executive Order 1-2008. If translation services are required by the Consultant, Contractor, Licensee, or Lessee to fulfill this obligation, it shall be at the sole cost and expense of the Consultant, Contractor, Licensee, or Lessee.

Please also note that the conviction of a crime(s) and/or being subject to a pending criminal charge(s) will not automatically result in a denial of a person's right to work on a County contract, right to be on County property, or license, but may, if the County determines that the prior conviction(s) or pending criminal charge(s) create an unacceptable risk. However, if a person fails to list or falsifies any part of his/her conviction history or any pending criminal charge(s) for any reason, he/she may be prohibited from working or being on County property without any risk assessment. If it is later determined that a Person Subject to Disclosure failed to disclose a criminal conviction or pending criminal charge for any reason, his/her right to work on a County contract, be on County property, or license may be terminated at any time.

Please further note that, pursuant to Executive Order 1-2008, and subject to the applicable provisions of New York Correction Law §§ 752 and 753, the County has the right to bar a Person Subject to Disclosure from providing work or services to the County or from being on County property if any such person has:

- a.) A conviction of a crime(s);
- b.) A pending criminal proceeding for a crime(s); or
- c.) Refused to answer questions concerning his/her criminal background

¹ For these disclosures, a "crime" or "pending criminal charge" includes all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State.

Please finally note that any failure by a County Consultant, Contractor, Licensee, or Lessee to comply with the disclosure requirements of Executive Order 1-2008 may be considered by the County to be a material breach and shall be grounds for immediate termination by the County of the related County contract.

Exemptions

Executive Order 1-2008 exempts from the aforementioned disclosure requirements Persons Subject to Disclosure:

- a.) for whom the County has already conducted a background check and issued a security clearance that is in full force and effect; and
- b.) for whom another state or federal agency having appropriate jurisdiction has conducted a security and/or background clearance or has implemented other protocols or criteria for this purpose that apply to the subject matter of a County contract that is in full force and effect.

If you are claiming an exemption for one or more Persons Subject to Disclosure, you must notify the Procuring Officer². The Procuring Officer will then determine whether the Person(s) Subject to Disclosure are actually exempt, and provide written notification of his/her determination. If the Procuring Officer determines that a Person Subject to Disclosure is not exempt, the Procuring Officer will notify you of that determination, and you will have to include disclosures for that person on your Criminal Background Disclosure Form and Certification.

² Procuring Officer” shall mean the head of the department or the individual or individuals authorized by the head(s) of the department(s) undertaking the procurement and with respect to those matters delegated to the Bureau of Purchase and Supply pursuant to Section 161.11(a) of the Laws of Westchester County, the Purchasing Agent.

Subconsultants, Subcontractors, Sublessees, or Sublicensees

Under Executive Order 1-2008, it is your duty to ensure that any and all approved subconsultants, subcontractors, sublessees, or sublicensees complete and submit the attached Criminal Background Disclosure Form and Certification for all of their respective Persons Subject to Disclosure. This must be done before such a subconsultant, subcontractor, sublessees, or sublicensees can be approved to perform work on a contract.

New Persons Subject to Disclosure

Under Executive Order 1-2008, you have a **CONTINUING OBLIGATION** to maintain the accuracy of the Criminal Background Disclosure Form and Certification (and any accompanying documentation) for the duration of this contract, including any amendments or extensions thereto. Accordingly, it is your duty to complete and submit an updated Criminal Background Disclosure Form and Certification whenever there is a new Person Subject to Disclosure for this contract. **NO NEW PERSON SUBJECT TO DISCLOSURE SHALL PERFORM WORK OR SERVICES OR ENTER ONTO COUNTY PREMISES UNTIL THE UPDATED CRIMINAL BACKGROUND DISCLOSURE FORM AND CERTIFICATION IS FILED WITH THE PROCURING OFFICER.** You shall also provide the County with any other updates that may be necessary to comply with the disclosures required by Executive Order 1-2008.

*PLEASE CONTINUE TO THE
Criminal Background Disclosure Form and Certification
BEGINNING ON THE NEXT PAGE*

CONTRACT #:

Name of Consultant, Contractor, Lessee, or Licensee: _____

**CRIMINAL BACKGROUND DISCLOSURE
FORM AND CERTIFICATION**

If this form is being completed by a subconsultant, subcontractor, sublessee, or sublicensee, please consider all references in this form to “consultant, contractor, lessee, or licensee” to mean “subconsultant, subcontractor, sublessee, or sublicensee” and check here: _____

I, _____, certify that I am a principal or a
(Name of Person Signing Below)

representative of the Consultant, Contractor, Lessee, or Licensee and I am authorized to complete and execute this Criminal Background Disclosure Form and Certification. I certify that I have asked each Person Subject to Disclosure the following questions:

- **Have you or your company ever been convicted of a crime (all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State) including, but not limited to, conviction for commission of fraud, embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements or receiving stolen property?**
- **Are you or your company subject to any pending criminal charges (all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State)?**

I certify that the names and titles of Persons Subject to Disclosure who refused to answer **either** of the questions above are:

1. _____
2. _____
3. _____
4. _____
5. _____

(If more space is needed, please attach separate pages labeled “REFUSED to Answer - Continued.”)

I certify that the names and titles of Persons Subject to Disclosure who answered “Yes” to **either of the** questions above are:

1. _____
2. _____
3. _____
4. _____
5. _____

(If more space is needed, please attach separate pages labeled “YES Answers - Continued.”)

Each Person Subject to Disclosure listed above who has either **been convicted of a crime(s)** and/or **is subject to a pending criminal charge(s)** must answer additional questions. Those questions are below.

A Person Subject to Disclosure who has **been convicted of a crime(s)** must respond to the following (please attach separate pages with responses for each person, with their name and title):

- 1.) Describe the reason for being on County property if applicable, identify the specific duties and responsibilities on this project which you intend to perform for the County, including but not limited to, access to sensitive data and facilities and access to vulnerable populations.
- 2.) Please list all criminal convictions along with a brief description of the crime(s) (including all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State).
- 3.) Please provide the date and place of each conviction.
- 4.) Please provide your age at the time of each crime for which you were convicted.
- 5.) Please provide the legal disposition of each case.
- 6.) Please provide any information either produced by yourself or someone on your behalf in regards to your rehabilitation and good conduct.

A Person Subject to Disclosure who **is subject to a pending criminal charge(s)** must respond to the following (please attach separate pages with responses for each person, with their name and title):

- 1.) Describe the reason for being on County property and if applicable, identify the specific duties and responsibilities on this project which you intend to perform for the County, including but not limited to, access to sensitive data and facilities and access to vulnerable populations.
- 2.) Please identify all pending criminal charges (all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State).
- 3.) Please briefly describe the nature of the pending charges and the date upon which it is alleged that a crime was committed.

I hereby certify that all of the information provided herein (and in any and all attachments) is true and accurate and that all disclosures required by Executive Order 1-2008 and this Criminal Background Disclosure Form and Certification have been completed. By my signature below, I hereby affirm that all of the facts, statements and answers contained herein (and in any and all attachments) are true and correct. I understand that providing false or incomplete information or withholding by omission or intention pertinent information will be cause for refusing further consideration of my being utilized under this contract.

It is understood and agreed that no Person Subject to Disclosure shall perform work or services or enter onto County property until this required Criminal Background Disclosure Form and Certification is filed with the Procuring Officer.

It is understood and agreed that to the extent that new Persons Subject to Disclosure are proposed to perform work or provide services under this contract after filing of this Criminal Background Disclosure Form and Certification with the Procuring Officer, such new Persons Subject to Disclosure shall not perform work or provide services or enter into County property until an updated Criminal Background Disclosure Form and Certification has been filed with the Procuring Officer.

It is further understood and agreed that the consultant, contractor, lessee, or licensee has a continuing obligation to maintain the accuracy of the Criminal Background Disclosure Form and Certification for the duration of this contract, including any amendments or extensions thereto, and shall provide any updates to the information to the County as necessary to comply with the requirements of Executive Order 1-2008.

Name: _____

Title: _____

Date: _____

Notary Public

Date

SUBCONTRACTOR'S SEALED BID SUBMISSION

Westchester County Contract No.: _____

Name of Subcontractor: _____

Address: _____

Phone #: _____ Fax #: _____

E-mail address: _____

Name of Contractor to whom
this bid is submitted: _____

Scope of Work to be performed by Subcontractor (e.g., electrical, plumbing, HVAC):

The price agreed upon by and between Contractor and Subcontractor for the full
performance of the Subcontractor's work:

\$: _____

In words (e.g, one hundred thousand dollars and xx/100):

Subcontractor

Contractor

Signature

Signature

By _____
(print name & title)

By _____
(print name & title)

**THE SUCCESSFUL LOW BIDDER, BEFORE AWARD OF THE CONTRACT, MUST
PROCURE AND PROVIDE TO THE COUNTY, FROM EACH OF THE ABOVE
DENOTED SUBCONTRACTORS, A CONTRACT DISCLOSURE STATEMENT
(PROPOSAL PAGES 24-32) AND THE REQUIRED DISCLOSURE OF
RELATIONSHIPS TO COUNTY (PROPOSAL PAGES 33-34)**

COMPLETE THIS FORM USING BLACK INK ONLY

INFORMATION FOR BIDDERS



2. INFORMATION FOR BIDDERS

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

INFORMATION FOR BIDDERS

1. ADDENDA AND INTERPRETATION

No interpretation of the meaning of the plans, specifications or other contract documents will be made to any bidder orally. Every request for such interpretation should be in writing addressed to the Westchester County Department of Public Works, Division of Engineering, Room 512, Michaelian Office Building, White Plains, New York, and to be given consideration must be received at least five (5) days prior to the date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the specifications which, if issued, will be posted on the internet not later than three (3) days prior to the date fixed for the opening of bids. Revisions to plans or drawings requiring the issuance of additional or revised drawings will be noted on the internet with instructions how to acquire copies of such revised plans or drawings. Failure of any bidder to receive any such addendum or interpretation or any other form, instrument or document shall not relieve any bidder from any obligation under its bid as submitted. All addenda so issued shall become part of the contract documents.

A bidder's failure to request a clarification, interpretation, etc. of any portion of the plans, specifications, or contract or to point out any inconsistency therein will preclude such bidder from thereafter claiming any ambiguity, inconsistency, or error which should have been discovered by a reasonably prudent bidder and from asserting any claim for damages arising directly or indirectly therefrom.

2. VOIDED CLAUSES

Wherever in this booklet any page is stamped "VOID", only the section(s) or paragraph(s) so stamped are void. All other sections(s) and paragraph(s) remain in full force and effect.

3. PRE-BID SITE INSPECTION

Unless otherwise stated, on building construction work, bidders are free and encouraged to examine the work site during normal work hours preceding the date on which bids are to be opened. For those bidders requesting further clarification of the conditions, an appointment with the County's representative, on the eighth day (Tuesday) prior to the bid opening date, can be requested, by contacting the, Department of Public Works, Division of Engineering at (914) 995-2553.

Each bidder must inform itself fully of the conditions relating to the work to be performed. Failure to do so will not relieve a successful bidder of the obligation to furnish all material and labor necessary to carry out the provisions of the contract documents and to complete the contemplated work for the consideration set forth in its Bid.

At the time of the opening of bids each bidder will be presumed to have inspected the sites and to have read and to be thoroughly familiar with the Plans and Contract Documents (including all addenda).

4. BID SECURITY

Bid Security shall be provided in accordance with the "Notice to Contractors." Where

INFORMATION FOR BIDDERS

a Performance and Payment bond is required in the Notice to Contractors, the executed “Bid Bond and Consent of Surety” of the Proposal Pages must be submitted with the Bid when the bid is more than \$100,000. The successful bidder, no matter the size of its bid, will be required to furnish a Performance and Payment Bond.

Where a Performance and Payment Bond is not specified in the Notice to Contractors, then the required Security may be furnished in the form of a Certified Check; drawn to the order of “County of Westchester, clipped to the top of the front cover and submitted with the Bid.

Certified checks submitted will be returned to all bidders submitting certified checks within three (3) days after the opening of bids unless the bidder or bidders submitting certified checks are among the two lowest bidders. At any time after the opening of bids, the second lowest bidder, if the second lowest bidder has submitted a certified check, may substitute a bid bond for the certified check by presenting the bond to the Secretary of the Board of Acquisition and Contract. This bond shall be in the form and coverage required by the County and shall be in an amount not less than the amount of the bidder's certified check. After receipt, approval and acceptance of the bond by the County, the County will forward to the bidder a County check in an amount equal to the bidder's certified check.

All certified checks submitted will be returned to the two lowest bidders within 48 hours after the successful bidder executes the required contract and furnishes the County with all necessary bonds and insurance certificates.

In the event that the successful bidder has not executed the required contract and furnished the required bonds and insurance certificates within forty-five (45) days after the opening of bids, the County, upon demand from a bidder (except for the successful bidder), will send a County check to the bidder in the amount of the bidder's certified check.

Failure of the successful bidder to execute the contract and furnish the necessary bonds and insurance certificates shall result in forfeiture of the bid security, such sum to be retained by the County as liquidated damages.

5. PERFORMANCE AND PAYMENT BOND

If required pursuant to "Notice to Contractors."

If a Performance and Payment bond is required in accordance with the “Notice to Contractors”, the “Bid Bond and Consent of Surety” of the Proposal Pages must be executed by the Contractor’s Surety Company and submitted with the Bid for all bids over \$100,000.

Simultaneously with its delivery of the executed contract, the successful bidder shall deliver to the County an executed bond in the amount of one hundred percent of the accepted bid as security for the faithful performance of its contract and in the amount of one hundred percent for the payment of all persons performing labor or furnishing materials in connection therewith, prepared in satisfactory form and having as surety thereon such bond underwriter or surety that appears on the U.S. Treasury’s listing of approved sureties (Department Circular 570), and is licensed to transact business in New York State. In the event such Surety ceases to appear on the U.S. Treasury’s listing of approved sureties (Department Circular 570) or ceases to be licensed to transact business in New York State or becomes insolvent or enters liquidation proceedings, the Contractor, at its sole cost, shall furnish a replacement bond from a surety satisfactory to the County.

INFORMATION FOR BIDDERS

The form of contract and Performance and Payment Bond to be used in connection with this Contract and to become a part of the contract documents is attached in the section entitled "Sample Contract and Bond for Construction".

6. INDEMNIFICATION AGREEMENT

The Contractor agrees:

- A. that except for the amount, if any, of damage contributed to, caused by or resulting from the negligence of the County, the Contractor agrees to indemnify and hold harmless the County of Westchester, its officers, employees, elected officials, and agents from and against any and all liability, damage, claims, demands, costs, judgments, fees, attorneys' fees or loss arising directly or indirectly out of the performance or failure to perform hereunder by the Contractor or third parties under the direction or control of the Contractor; and
- B. to provide defense for and defend, at its sole expense, any and all claims, demands or causes of action directly or indirectly arising out of the Agreement and to bear all other costs and expenses related thereto.

7. INSURANCE REQUIREMENTS

The Contractor, upon award of the contract and throughout the term of the Agreement, shall obtain at its own cost and expense the required insurance as delineated below from insurance companies licensed in the State of New York, carrying a Best's financial rating of A or better. Contractor shall provide evidence of such insurance to the County of Westchester ("County"), either by providing a copy of policies and/or certificates as may be required and approved by the Director of Risk Management of the County ("Director"). The policies or certificates thereof shall provide that ten (10) days prior to cancellation or material change in the policy, notices of same shall be given to the Board of Acquisition and Contract of the County of Westchester by registered mail, return receipt requested, for all of the following stated insurance policies, with a copy also sent to the Director of Risk Management of the County. All notices shall name the Contractor and identify the Contract Number.

If at any time any of the policies required herein shall be or become unsatisfactory to the Director, as to form or substance, or if a company issuing any such policy shall be or become unsatisfactory to the Director, the Contractor shall upon notice to that effect from the County, promptly obtain a new policy, and submit the policy or the certificate as requested by the Director to the Office of Risk Management of the County for approval by the Director. Upon failure of the Contractor to furnish, deliver and maintain such insurance, the Agreement, at the election of the County, may be declared suspended, discontinued or terminated.

Failure of the Contractor to take out, maintain, or the taking out or maintenance of any required insurance, shall not relieve the Contractor from any liability under the Agreement, nor shall the insurance requirements be construed to conflict with or otherwise limit the contractual obligations of the Contractor concerning indemnification.

All property losses shall be made payable to the "County of Westchester" and adjusted with the appropriate County personnel.

In the event that claims, for which the County may be liable, in excess of the insured amounts provided herein are filed by reason of Contractor's negligent acts or omissions under the

INFORMATION FOR BIDDERS

agreement or by virtue of the provisions of the labor law or other statute or any other reason, the amount of excess of such claims or any portion thereof, may be withheld from payment due or to become due the Contractor until such time as the Contractor shall furnish such additional security covering such claims in form satisfactory to the Director.

In the event of any loss, if the Contractor maintains broader coverage and/or higher limits than the minimums identified herein, the County shall be entitled to the broader coverage and/or higher limits maintained by the Contractor. Any available insurance proceeds in excess of the specified minimum limits of insurance and coverage shall be available to the County.

The Contractor shall provide proof of the following coverage. (Other coverage may be required by the County of Westchester based on specific needs. If such other coverages are required for a specific contract, those coverages will be described in the "Special Clauses" of the contract specifications):

- a) Workers' Compensation and Employer's Liability. Certificate form C-105.2 or State Fund Insurance Company form U-26.3 is required for proof of compliance with the New York State Workers' Compensation Law. State Workers' Compensation Board form DB-120.1 is required for proof of compliance with the New York State Disability Benefits Law. Location of operation shall be "All locations in Westchester County, New York."

Where an applicant claims to not be required to carry either a Workers' Compensation Policy or Disability Benefits Policy, or both, the employer must complete NYS form CE-200, available to download at: <http://www.wcb.ny.gov>.

If the employer is self-insured for Workers' Compensation, he/she should present a certificate from the New York State Worker's Compensation Board evidencing that fact (Either SI-12, Certificate of Workers' Compensation Self-Insurance, or GSI-105.2, Certificate of Participation in Workers' Compensation Group Self-Insurance).

- b) Commercial General Liability Insurance with a combined single limit of \$1,000,000 (c.s.1) per occurrence and a \$2,000,000 aggregate limit naming the "County of Westchester" as an additional insured on a primary and non-contributory basis. This insurance shall include the following coverages:
 - i. Premises - Operations.
 - ii. Broad Form Contractual.
 - iii. Independent Contractor and Sub-Contractor.
 - iv. Products and Completed Operations.

NOTE: Additional insured status shall be provided by standard or other endorsement that extends coverage to the County of Westchester for both on-going and completed operations.

All Contracts involving the use of explosives, demolition and/or underground work shall provide proof that XCU is covered.

- c) Commercial Umbrella/Excess Insurance: \$2,000,000 each Occurrence and Aggregate naming the "County of Westchester" as additional insured, written on a "follow the form" basis.
- d) Owners Protective Liability Policy naming the County as insured, with a minimum limit of liability per occurrence of \$3,000,000 (where applicable, or as determined by the Director, Risk Management)
- e) Automobile Liability Insurance with a minimum limit of liability per occurrence of \$1,000,000 for bodily injury and a minimum limit of \$100,000 per occurrence for property damage or a

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combined single limit of \$1,000,000 unless otherwise indicated in the contract specifications. This insurance shall include for bodily injury and property damage the following coverages and name the "County of Westchester" as additional insured:

- i. Owned automobiles.
 - ii. Hired automobiles.
 - iii. Non-owned automobiles.
- f) Construction Insurance: For the construction, renovation or repair of bridges, viaducts or similar structures, the Contractor at its own cost and expense shall provide and maintain a "Bridge Builder's Risk Form, All Risk Insurance Contract," with flat premium endorsement, until the construction contract is accepted by the Board of Acquisition and Contract of the County of Westchester. The coverage shall be written for 100% of the completed value, covering the Contractor and County of Westchester as the insureds. The Contractor shall provide the original and duplicate policy to the County (unless the County shall accept, in lieu thereof, all contained endorsements including all applicable provisions and coverages).

For the construction of (a) new buildings and (b) for additions or repairs of existing buildings or structures, the Contractor at its own cost and expense shall provide and maintain a "Builder's Risk Form, All Risk Insurance Contract," with flat premium endorsement, until the construction contract is accepted by the Board of Acquisition and Contract of the County of Westchester. The coverage shall be written for 100% of the completed value, covering the Contractor and County of Westchester as the insureds. The Contractor shall provide the original and duplicate policy to the County (unless the County shall accept, in lieu thereof, all contained endorsements including all applicable provisions and coverages).

All policies of the Contractor shall be endorsed to contain the following clauses:

(a) Insurers shall have no right to recovery or subrogation against the County (including its employees and other agents and agencies), it being the intention of the parties that the insurance policies so effected shall protect both parties and be primary coverage for any and all losses covered by the above-described insurance.

(b) The clause "other insurance provisions" in a policy in which the County is named as an insured, shall not apply to the County.

(c) The insurance companies issuing the policy or policies shall have no recourse against the County (including its agents and agencies as aforesaid) for payment of any premiums or for assessments under any form of policy.

(d) Any and all deductibles in the above described insurance policies shall be assumed by and be for the account of, and at the sole risk of, the Contractor.

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8. PREVAILING WAGE RATES AND SUPPLEMENTS

A. Wages to be Paid and Supplements to be Provided

Each laborer, workman or mechanic employed by the Contractor(s), Sub-contractor(s) or other person(s) doing or contracting to do the whole or part of the work contemplated by this Contract, shall be paid the prevailing wages and provide the supplements (including but not limited to health, welfare and pension benefits) as required by Article 8 (Section 220-223) and Article 9 (230-239) of the New York State Labor Law.

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B. Schedule of Hourly Rates/Supplements

The "Schedule of Hourly Rates and Supplements" shows the prevailing hourly rates of wages to be paid and supplements to be provided. It is the County's preference that such supplements shall be paid to a Federally qualified Pension, Health and Welfare program and New York State Registered Apprentice Training Program.

Classifications not appearing on the rate sheet can be used only with the consent of the Commissioner of Public Works and then the rate to be paid will be given by the Commissioner of Public Works after advising with the State Department of Labor.

C. Grounds for Cancellation of Contract

In the event of a failure, to pay the prevailing wages and provide the supplements in accordance with the New York State Labor Law, and as described in this Contract, it shall be considered a material breach. For the breach or violation of this provision, without limiting any other rights or remedies to which the County or any individual may be entitled or any civil or criminal penalty for which any violator may be liable, the County shall have the right, in its discretion, to terminate this agreement immediately upon notice. In such event, the Contractor(s), Sub-Contractor(s), et al shall be liable to the County for any additional costs incurred by the County in the completion of the project.

In addition to any other remedies available to the County and irrespective of any applicable penalties pursuant to law, the County may deduct from the amount payable to the Contractor under this contract five hundred (\$500.00) dollars as reimbursement for the costs it incurs in investigating any violation of Section 220 of the Labor Law.

D. Records to be kept on Site

The Contractor(s), Sub-contractor(s), et al. shall certify their payrolls and keep them on site and available, in addition to the following informative records:

- 1) Record of hours worked by each workman, laborer and mechanic on each day;
- 2) Record of days worked each week by each workman, laborer and mechanic;
- 3) Schedule of occupation or occupations at which each workman, laborer and mechanic on the project is employed during each work day and week;
- 4) Schedule of hourly wage rates paid to each workman, laborer and mechanic for each occupation.
- 5) A statement or declaration signed by each workman, laborer and mechanic attesting that they have been provided with a written notice, informing them of the prevailing wage rates and supplements requirement for this contract.

E. Responsibility of the Contractor, Sub-Contractor, et al.

The Contractor(s), Sub-Contractor(s), et al. will display the posters in a conspicuous location at the site and distribute the wallet cards to the employees. These posters and wallet cards will inform the employees that they are entitled to receive the prevailing wages and supplements as determined by the Department of Labor and will list the

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Department of Labor's Public Work field offices, with phone numbers for individuals to call if they believe their rights are being violated.

F. Pay for a Legal Day's Work & Use of Apprentices

The wages to be paid for a legal day's work, as hereinbefore defined, to laborers, workmen or mechanics upon such public works, shall be not less than the prevailing rate of wages as hereinafter defined. Serving laborers, helpers, assistants and apprentices shall not be classified as common labor and shall be paid not less than the prevailing rate of wages as hereinafter defined. No employee shall be deemed to be an apprentice unless he is individually registered in an apprenticeship program which is duly registered with the Industrial Commissioner in conformity with the provision of Article 23 of the Labor Law. The wages to be paid for a legal day's work, as hereinbefore defined, to laborers, workmen or mechanics upon any material to be used upon or in connection therewith shall be not less than the prevailing rate for a day's work in the same trade or occupation in the locality within the state where such public work on, about or in connection with which such labor is performed in its final or completed form is to be situated, erected or used and shall be paid in cash; provided, however, that an employer may pay his employees by check upon a Certificate of the Industrial Commissioner to be issued only after a hearing upon the application to pay by check, which hearing shall be with notice of at least five days to be served personally or by mail on all interested persons, or if not served as aforesaid, then to be published in a manner directed by the Industrial Commissioner, which shall afford interested persons the opportunity to appear and to be heard at such hearing, and after proof has been furnished satisfactorily to the Industrial Commissioner of the employer's financial responsibility and the employer gives assurance that such checks may be cashed by employees without difficulty and for the full amount for which they are drawn. Such Contracts shall contain a provision that each laborer, workman or mechanic, employed by such Contractor, Subcontractor or other person about or upon such public works, shall be paid the wages herein provided.

G. Fiscal Officer's Duty to Determine Schedule of Wages

It shall be the duty of the fiscal officer (the "New York State Commissioner of Labor"), to ascertain and determine the schedule of wages to be paid workmen, laborers and mechanics on each such public work, prior to the time of the advertisement for bids, and such schedule of wages shall be annexed to and form a part of the specifications for the work. Such fiscal officer shall file with the department having jurisdiction such schedule of wages to the time of the commencement of the advertisement for bids on all public works proposed to be constructed. The term "Contract" as used in this subdivision also shall include reconstruction and repair of any such public work.

Where Contracts are not awarded within ninety days of the date of the establishment of the prevailing rate of wages by the fiscal officer, the department of jurisdiction shall request of the fiscal officer a redetermination of a schedule of wages.

H. Penalty for Payment of Less than Prevailing Wages

Any person or corporation that willfully pays after entering into such Contract, less than such stipulated wage scale as established by the fiscal officer shall be guilty of a

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misdemeanor and upon conviction shall be punished for such first offense by a fine of five hundred dollars or by imprisonment for not more than thirty days, or both fine and imprisonment; for a second offense by a fine of one thousand dollars, and in addition thereto the Contract on which the violation has occurred shall be forfeited and no such person or corporation shall be entitled to receive any sum nor shall any officer, agent, or employee of the state, municipal corporation or commission or board appointed pursuant to law pay the same or authorize its payment from the funds under his charge or control to any person or corporation for work done upon any Contract, on which the Contractor has been convicted for a second offense in violation of the provisions of this section.

9. LABOR AND COMPLIANCE WITH LABOR LAW

A. Preference for Westchester Residents

The Contractor agrees that in the performance of the work under this Contract he will give preference, and so far as legally possible, to employ citizens and residents of Westchester County.

B. Certifications To Be Filed

It is agreed that, in accordance with Section 220-d of the Labor Law as amended before final payment by or on behalf of the County for any sum due on account of a Contract for a public improvement, the Contractor and each and every Subcontractor of the Contractor or a Subcontractor is required to file a statement in writing in form satisfactory to the Commissioner of Finance certifying to the amounts then due and owing from such Contractor or Subcontractor filing such statement to or on behalf of any and all laborers for daily or weekly wages or supplements on account of labor performed upon the work under the Contract, setting forth therein the names of the persons whose wages or supplements are unpaid and the amount due to each or on behalf of each respectively, which statement so to be filed shall be verified by the oath of the Contractor or Subcontractor as the case may be that he has read such statement subscribed by him and knows the contents thereof, and that the same is true to his own knowledge.

C. Retention of Funds

It is further agreed that in accordance with Section 220b of the Labor Law, as amended:

- 1) In case any interested person shall have previously filed a protest in writing objecting to the payment to any Contractor or Subcontractor to the extent of the amount or amounts due or become due to him/her for daily or weekly wages or supplements for labor performed on the public improvement for which such Contract was entered into, or if for any other reason it may be deemed advisable, the Commissioner of Finance may deduct from the whole amount of any payment on account thereof the sum or sums admitted by any Contractor or Subcontractor in such statement or statements so filed to be due and owing by him on account of labor performed on such public improvement before making payment of the amount certified for payment in any estimate or voucher, and may withhold the amount so deducted for the benefit of the laborers, workmen or mechanics whose

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wages or supplements are unpaid or not provided, as the case may be, as shown by the verified statements filed by any Contractor or Subcontractor, and may pay directly to any person the amount or amounts shown to be due to him or his duly authorized collective bargaining labor organization, as the case may be, for such wages or supplements by the statements filed as hereinbefore required, thereby discharging the obligation of the Contractor or Subcontractor to the person or his duly authorized collective bargaining labor organization receiving such payment to the extent of the amount thereof, or

- 2) When any interested person shall file a written complaint with the fiscal officer as defined in section 220-b of the Labor Law, alleging unpaid wages or supplements due for labor performed on a public improvement for which a Contract has been entered into, and said labor is alleged to have been performed within the two year period immediately preceding the date of the filing of said complaint, or if, on the fiscal officer's own initiative, unpaid wages or supplements appear to be due, the fiscal officer shall immediately so notify the financial officer of the civil division interested, or, if there are insufficient moneys still due to the Contractor or Subcontractor to satisfy said wages and supplements, including interest and penalty, the financial officer of another civil division which has entered or subsequently enters into a public improvement contract with the Contractor or Subcontractor, who shall withhold from any payment due or earned by the Contractor or Subcontractor executing said public improvement, sufficient moneys to satisfy said wages and supplements, including interest at the rate provided herein, and any civil penalty that may be assessed as provided herein, pending a final determination. The Commissioner of Finance shall immediately confirm in writing to the fiscal officer the amount of money withheld.
- 3) Moneys withheld pursuant to this section shall be held by the Commissioner of Finance for the sole and exclusive benefit of the workers employed on said public improvement and for payment of any civil penalty that may be assessed as provided herein and shall not be used for any other purpose except upon court order. Any person, partnership, association, corporation or governmental body who files a lien or commences a judicial proceeding with respect to any moneys withheld pursuant to this section shall notify the fiscal officer in writing of the lien or claim on or before the date of filing of the lien or commencement of the judicial proceeding. In any proceeding to obtain moneys withheld pursuant to this section by any person, partnership, association, corporation or governmental body, the Commissioner of Labor shall have the right to appear and be heard.
- 4) The fiscal officer shall then cause an investigation to be made to determine whether any amounts are due to the laborers, workmen or mechanics, or on their respective behalves, on such public improvement, for labor performed after the commencement of the three-year period immediately preceding the filing of the complaint or the commencement of the investigation on his own initiative, as the case may be, and shall order a hearing therein at a time and place to be specified and shall give notice thereof, together with a copy of such complaint, or a statement of the facts disclosed upon such investigation, which notice shall be served personally or by mail on all interested persons, including the person complained

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against and upon the financial officer of the civil division; such person complained against shall have an opportunity to be heard in respect to the matters complained of, at the time and place specified in such notice, which time shall be not less than five days from the service of said notice. The fiscal officer in such an investigation shall be deemed to be acting in a judicial capacity and shall have the rights to issue subpoenas, administer oaths and examine witnesses. The enforcement of a subpoena issued under this section shall be regulated by the Civil Practice Law and Rules. Such investigation and hearing shall be expeditiously conducted, and upon such hearing and investigation, the fiscal officer shall determine the issues raised thereon and shall make and file an order in his office stating such determination and forthwith serve a copy of such order, either personally or by mail, together with notice of filing, upon the parties to such proceedings, and if the fiscal officer be the Comptroller, upon the Commissioner of the Department of Labor. Such order shall direct payment of wages or supplements found to be due, including interest at the rate of interest then in effect as prescribed by the Superintendent of Banks pursuant to Section fourteen (a) of the Banking law per annum from the date of the underpayment to the date of payment.

- 5) In addition to directing payment of wages or supplements, including interest found to be due, the order of the fiscal officer may direct payment of a further sum as a civil penalty in an amount not exceeding twenty-five percent of the total amount found to be due. In assessing the amount of the penalty, due consideration shall be given to the size of the employer's business, the good faith of the employer, the gravity of the violation, the history of previous violations of the employer or any successor or substantially-owned affiliated entity or any of the partners if the Contractor or Subcontractor is a partnership or any of the five largest shareholders of the Contractor or Subcontractor, as determined by the fiscal officer, and any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article, and the failure to comply with record keeping or other non-wage requirements. Upon the fiscal officer's determination of the penalty, where the fiscal officer is the Commissioner of the Department of Labor, the penalty shall be paid to said Commissioner for deposit in the State Treasury.
- 6) Upon the entry and service of such order, the Commissioner of Finance shall pay to the claimant, from the moneys due to the Contractor or Subcontractor, the amount of the claim as determined by the fiscal officer and the amount of the civil penalty, if any, shall be paid as provided herein, provided that no proceeding pursuant to Article Seventy-Eight of the Civil Practice Law and Rules for review of said order is commenced by any party aggrieved thereby within thirty days from the date of said order was filed in the office of the fiscal officer. Said proceeding shall be directly in the appellate division of the Supreme Court. Where the fiscal officer is the Commissioner of the Department of Labor, the civil penalty shall be paid to said Commissioner for deposit in the State Treasury. In the event that such a proceeding for review is instituted, moneys sufficient to satisfy the claim and civil penalty shall be set aside by the Commissioner of Finance, subject to the order of the Court.

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- 7) When final determination has been made and such determination is in favor of the complainant, said complainant may in addition to any other remedy provided by this article, institute an action in any Court of appropriate jurisdiction against the person or corporation found violating this article, any substantially-owned affiliated entity or any successor of the Contractor or Subcontractor, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article, and any of the partners if the Contractor or Subcontractor is a partnership or any of the five largest shareholders of the Contractor or Subcontractor, as determined by the fiscal officer, for the recovery of the difference between the sum, if any, actually paid to him by the Commissioner of Finance pursuant to said order and the amount found to be due him as determined by said order. Such action must be commenced, within three years from the date of the filing of said order, or if the said order is reviewed in a proceeding pursuant to Article Seventy-eight of the Civil Practice Law and Rules, within three years after the termination of such review proceeding.

- 8) When two final determinations have been rendered against a Contractor, Subcontractor, successor, or any substantially owned affiliated entity of the Contractor or Subcontractor, any of the partners if the Contractor or Subcontractor is a partnership, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article, any of the five largest shareholders of the Contractor or Subcontractor or any successor within any consecutive six-year period determining that such Contractor, Subcontractor, successor, or any substantially-owned affiliated entity of the Contractor or Subcontractor, any of the partners or any of the five largest shareholders of the Contractor or Subcontractor, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article has willfully failed to pay the prevailing rate of wages or to provide supplements in accordance with this article, whether such failures were concurrent or consecutive and whether or not such final determinations concerning separate public work projects are rendered simultaneously, such Contractor, Subcontractor, successor, or any substantially-owned affiliated entity of the Contractor or Subcontractor, any of the partners if the Contractor or Subcontractor is a partnership or any of the five largest shareholders of the Contractor or Subcontractor, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article shall be ineligible to submit a bid on or be awarded any public work contract or subcontract with the State, any municipal corporation or public body for a period of five years from the second final determination, provided, however, that where any such final determination involves the falsification of payroll records or the kickback of wages or supplements, the Contractor, Subcontractor, successor, or any substantially-owned affiliated entity of the Contractor or Subcontractor, any partner if the Contractor or Subcontractor is a partnership or any of the five largest shareholders of the Contractor or Subcontractor, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article shall be ineligible to submit a bid on or be awarded any public work contract with the State, any municipal corporation or public body for a period of five years from the first final determination.

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- 9) Nothing in this subdivision shall be construed as affecting any provision of any other law or regulation relating to the awarding of public contracts.

Pursuant to Section 220-C of the Labor law, any Contractor or Subcontractor who shall upon his oath verify any statement required to be filed herein, which is known by him to be false, shall be guilty of perjury and punishable as provided by the Penal Law.

10. CONTRACTOR'S REPORT OF EMPLOYMENT AND WEEKLY AFFIDAVIT

Each week the Contractor shall furnish to the Commissioner of Public Works the "Contractor's Report Of Employment And Weekly Affidavit" of the Sample Forms.

11. LAWS/REGULATIONS AND APPROPRIATIONS

- A. The Contractor shall, at its own cost and expense, comply with all provisions of the Labor Law (i.e. prevailing rate of wages and supplements), Lien Law, Workmen's Compensation Law and all other laws and ordinances affecting this contract or order, either Federal, State or local.
- B. It is recognized and understood by the Parties that when this Agreement is subject to future appropriation by the Westchester County Board of Legislators for funds not presently appropriated to pay for this Agreement; the County shall have no liability under this agreement beyond the funds, if any, that are appropriated and available for payment of the amounts due under this Agreement. The Parties understand and intend that the obligation of the County to pay the amounts due hereunder shall constitute a current expense of the County and shall not in any way be construed to be a debt of the County in contravention of any applicable constitutional or statutory limitations or requirements concerning the creation of indebtedness by the County, nor shall anything contained in this Agreement constitute a pledge of the general tax revenues, funds or monies of the County. The County shall pay amounts due under this Agreement exclusively from legally available funds appropriated for this purpose. Notwithstanding the foregoing, the County will do all things lawfully within its power to obtain, maintain, and properly request and pursue funds from which payments under this Agreement may be made, including: (i) the County Executive making provisions for such payments to the extent necessary in the annual budget submitted to the Board of Legislators for the purpose of obtaining funding; and (ii) using its reasonable efforts to have such portion of the budget approved.

12. REFUSAL TO ANSWER QUESTIONS

It is understood and agreed by the Contractor that he/she bears an affirmative obligation to answer questions specifically or directly relating to this agreement before any official, board or agency authorized or empowered to inquire into such matters. This section shall not be construed as barring the Contractor, its directors, officers or employees from exercising their constitutional privilege against self-incrimination.

The foregoing, however, shall not be construed as limiting the rights and remedies of the County in the event of such refusal, and when such body or agency is wholly civil in nature,

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failure or refusal to fully cooperate with and diligently answer the inquiries of such official, board or agency may constitute grounds for the termination of this agreement and/or the exercise of any and all other rights or remedies which the County may have by reason of such failure or refusal.

Any and all contracts made with the State, the County of Westchester, or any public department, agency or official thereof, since July 1, 1959 by such person and by any firm, partnership or corporation of which he is a member, partner, director or officer, may be canceled or terminated by the County of Westchester, without incurring any penalty or damages on account of such cancellation or termination, but any monies owing pursuant to said transaction or contract prior to the cancellation and termination, shall be paid.

The successful bidder will be required to make all books and records concerning this contract available during business hours, upon reasonable notice, to duly authorized County personnel for the purpose of ascertaining compliance and/or performance of all provisions of this contract. This provision shall survive the termination of this agreement and for a period of six (6) years thereafter.

13. BID REQUIREMENTS

The Bid must be made on the "Proposal Pages" included in this specification or as provided with an addendum. All blank spaces on said Proposal Pages must be filled in and no change shall be made in the phraseology or in the items as contained therein.

Any bid which fails to name a price per unit of measurement for each of the items for which quantities are given, may be held to be informal and rejected. Bids submitted on Proposal Pages that contain any omissions, alterations, additions or items not called for in the bid documents, or that are illegible, unbalanced, conditional, incomplete or contain irregularities of any kind, may be rejected as informal. If the various parts of the work have been divided into classes and/or items to enable the bidder to bid for different portions of the work in accordance with its estimate of their costs, in the event of any increase or decrease in the quantity will be paid for at the price bid for that particular item. The sum of the amounts for each class or item, obtained by multiplying the approximate quantity by the unit price, shall constitute the total sum bid.

In the event of a discrepancy between the written bid amount and the numerical bid amount, the written amount will take precedence and be controlling as to the amount of the Bid. Any such discrepancy shall be corrected as set forth in Article "Correction Of Errors" of the Information for Bidders.

14. MISCELLANEOUS ADDITIONAL WORK (ITEM W-800)

A. Description - Under this item each Contractor shall furnish all labor, material and equipment required to accomplish miscellaneous additional work:

- 1) Necessitated by encountering during the course of the work field conditions of a nature not determinable during design; or
- 2) For which no unit prices are applicable.

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- B. Method of Measurement - Only that miscellaneous additional work shall be performed by the Contractor and will be paid for by the County, which has been authorized by the Commissioner or the Construction Administrator in writing, prior to its commencement.
- C. Article “Increase or Decrease of Quantities: Elimination of Items” of the Information for Bidders, will still apply relative to the percentage of the total awarded contract price that the work under the contract may be increased or decreased.
- D. Payment - The total amount paid to the Contractor will be determined in strict accordance with the provisions of Article “Extra Work: Increased Compensation/ Decreased Work: Credit to the Owner” of the General Clauses, and such payment will include only that overhead and profit that is applicable to the work performed under this item.
- E. Each Contractor shall include in its total bid the lump sum printed in the Proposal and any bid other than the specified amount will be considered informal.

15. CORRECTION OF ERRORS

Relative to dollar bid items and the required computations as submitted and performed by bidders on the proposal sheets, if there are any inconsistencies derived in multiplying unit bid prices by the stated quantities, the Commissioner reserves the right to reconcile the unit bid prices or the products of the unit bid prices and the stated quantities, when in the Commissioner's professional opinion such reconciliation(s) would concur with the apparent intent of a bidder and the Commissioner's estimated values of the respective bid items of the proposed contract work. In addition to the foregoing, the Commissioner reserves the right to correct all mathematical errors in additions or subtractions.

16. SHOWN QUANTITIES

All bids shall be submitted upon the following express conditions, which shall apply to and become a part of every bid received. The Bidders accept the quantities shown on the Proposal Pages opposite items of the work for which unit prices are to be bid as being approximate estimated quantities. Bidders shall satisfy themselves by personal examination of the location of the proposed work and surroundings thereof, and by such other means as they may prefer, as to the scope of the work and the accuracy of the approximate estimated quantities; and shall not at any time after submission of their bids dispute such approximate estimated quantities nor assert that there was any misrepresentation by the County or any misunderstanding by the Contractor in regard to the quantity or kind of materials to be furnished, or work to be done.

17. QUALIFICATION OF BIDDERS

The County may make such investigation as it deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish all information and data for this purpose as may be requested. The County reserves the right to reject any bid if the evidence submitted by, or the investigation of such bidder fails to satisfy the County, in the County's sole discretion, that it is properly qualified to carry out the obligations of the contract and to complete the contemplated work.

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18. REQUIRED EXPERIENCE

The County requires that each contractor possess not less than five (5) year's experience in performing work substantially similar in scope and size to the work for which it is bidding. The contractor agrees that upon request of the County the contractor will furnish a detailed statement of each project that it has performed during the most recent five (5) years (including but not limited to the name and address of the project, the name of the awarding entity/owner, the name of the awarding entity's/owner's representative, a current telephone number where that representative can be reached, the description of the project, general scope of the contractor's work, contract price, dates of performance, whether the contract was terminated for cause or convenience, whether the contract was completed and whether liquidated damages were assessed against the contractor [and if so, provide a written explanation]). The County reserves the right to require additional information as it deems appropriate concerning the history of the contractor's performance of each such contract. The final determination of whether the contractor possesses the requisite experience rests in the sole discretion of the County.

19. INCREASE OR DECREASE OF QUANTITIES: ELIMINATION OF ITEMS

In entering into this contract, the Contractor agrees that quantities shown on the Proposal Pages opposite items of the work for which unit prices have been requested are approximate estimated quantities, and that during the progress of the work the County may find it advisable and shall have the right to omit portions of the work, and to increase or decrease the shown approximate estimated quantities, or the scope of the whole work; and that the County reserves the right to add to or take from the total amount of the work up to a limit of thirty percent of the total amount of the contract based upon the executed contract price for all the specified work.

The Contractor shall make no claim for anticipated profits or loss of profits, because of any difference between the quantities of the various classes of work actually done, or of the materials actually furnished, and the original specified scope of work and the shown approximate estimated quantities.

The aforesaid thirty- percent pertains to the total amount of the contract and not to any individual item. Individual items may be increased or decreased any amount or may be eliminated entirely if so ordered by the Commissioner, excepting that the total amount of the contract as adjusted shall not result in a net increase or decrease of more than thirty percent except by mutual agreement between both parties thereto.

The Contractor waives all claims of any nature due to a misunderstanding of the location, character, or other conditions surrounding the work or of the shown approximate estimated quantities of items of the work.

20. BREAKDOWN COST OF LUMP SUM ITEMS AND CONTRACTS

After award of the contract and prior to actual start of the work, the successful bidder shall submit an itemized schedule of its estimated costs of lump sum items and or lump sum total contract work, for approval by the County. The schedule shall be submitted as an outline series with minor subdivisions, in accordance with the directives of the County. As part of

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this Schedule, the Contractor will be required to include a sum sufficient, as determined in the County's sole discretion, for the preparation and submission of approved final "As-builts", record drawings, guarantees, warranties, and operations and maintenance manuals.

21. ENGINEERING CHARGES

In addition to any and all other remedies available to the County when the work embraced in the contract is not completed on or before the date specified herein, engineering and inspection expenses incurred by the County of Westchester upon the work from the completion date originally fixed in the contract to the final date of completion of the work may be charged to the Contractor and be deducted from monies due the Contractor. Consideration of any extra work or supplemental contract work added to the original contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due consideration by the County before assessing engineering and inspection charges against the Contractor. Such charges will be assessed, however, in cases where in the opinion of the Commissioner, the Contractor has delayed the work.

22. ESTIMATES AND PAYMENTS

As the work progresses but not more often than once a month and then on such days as the Construction Administrator may fix, the Contractor will submit a requisition in writing of the amount and value of the work performed and the materials and equipment provided to the date of the requisition, less any amount previously paid to the Contractor. The Contractor must complete at least ten (10%) percent of the work before submitting any claims for mobilization. From each requisition, the County will retain five percent (5%) plus one hundred fifty percent (150%) of the amount necessary to satisfy any claims, liens or judgments against the Contractor that have not been suitably discharged. The Commissioner will thereupon cause the balance of the requisition therein to be paid to the Contractor. In lieu of all or part of the cash retainage the County shall only accept bonds or notes of United States of America, New York State or political subdivisions thereof. As a condition to the making of any progress payment as set forth in this paragraph, the County, in its sole discretion may require the Contractor to submit such document as may be reasonably required to establish that the Contractor (and its subcontractor(s)) have timely and properly paid their respective subcontractor(s) and materialmen of whatever tier.

VENDOR DIRECT PAYMENT: All payments made by the County to the Contractor will be made by electronic funds transfer ("EFT") pursuant to the County's Vendor Direct program. The Contractor is required to complete the Vendor Direct Payment Authorization Form, which is located in the Forms Section on page 11 and 12. Payments will be automatically credited to the Contractor's designated bank account at the Contractor's financial institution. Payments are anticipated to be deposited two business days after the voucher/invoice is processed for payment. Saturdays, Sundays, and legal holidays are not considered business days. Under the Vendor Direct program you will receive an e-mail notification two days prior to the day the payment will be credited to your designated account. The e-mail notification will come in the form of a remittance advice with the same information that currently appears on County check stubs and will contain the date that the funds will be credited to your account. If there is a discrepancy in the amount received please contact

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your Westchester County representative as you would have in the past if there were a discrepancy in a check.

In the unlikely event that you do not receive the money in your designated bank account on the date indicated in the e-mail, please contact the Westchester County Accounts Payable Department at 914-995-3748. Whenever you change your bank or change or close your account a new Vendor Direct Payment Authorization Form must be submitted. Please contact the Westchester County Accounts Payable Department at 914-995-3748 and a new form will be e-mailed to you. When completing the payment authorization form you must either supply a voided check or have it signed by a bank official to ensure the authenticity of the account being set up to receive your payments. Failure to return the completed authorization form prior to award of the contract may result in the bid being considered non-responsive and the bid may be rejected.

When the work or major portion thereof, as contemplated by the terms of the contract (see Substantial Completion Payment and Final Payment later in this article), are substantially completed in the judgment of the Commissioner, the Contractor shall submit a requisition for the remainder of the contract balance. An amount equal to two (2) times the value of the remaining items to be completed plus one hundred fifty percent (150%) of the amount that the Commissioner deems necessary to satisfy to satisfy any claims, liens or judgments against the Contractor which have not been suitably discharged shall be deducted from the requisition. As the remaining items of work are satisfactorily completed or corrected, the County will, upon receipt of a requisition, pay for these items less one hundred fifty percent (150%) of the amount necessary to satisfy any claims, liens or judgments.

Contractor agrees, in the event of any withdrawal by the contractor of amounts retained from payments to the contractor pursuant to the terms hereof, that notwithstanding any contrary interpretation of Section 106 of the New York General Municipal Law, the contractor will be obliged to maintain the market value of securities deposited in an amount equal to the amount withdrawn pursuant to said Section 106. The Contractor will, within five (5) days of demand therefore by the fiscal officer of the County, deposit with such fiscal officer cash, or securities of the kind provided in Section 106, of a market value sufficient to maintain the market value of all securities on deposit at a level equal (as of the date such notice of the fiscal officer is given to the contractor) to the amount which the County shall be entitled to retain from payments to the contractor pursuant to the terms of the contract.

All estimates will be made for actual quantities for work performed and materials and equipment incorporated in the work as determined by the measurements of the Engineer, and this determination shall be accepted as final, conclusive and binding upon the Contractor. All estimates will be subject to correction in any succeeding estimate.

Payment will be made for materials pertinent to the project which have been delivered to the site or off-site by the Contractor and/or Subcontractor and suitably stored and secured in first-class condition as required by the Construction Administrator. Payment may be limited to materials in short and/or critical supply and materials specially fabricated for the project, as defined by the contract. Payment will be made only upon the written request of the contractor. The Contractor must submit certified copies of the manufacturer's or vendor's invoices or statements establishing the true purchase value of the material or equipment; freight bills, release of liens and certificate of insurance covering all equipment and materials. Then the County will include in the following monthly payment an amount not to

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exceed the lesser of the bid breakdown or the total purchase price of the stored equipment and materials less retainage provided that such equipment and materials are suitable for their intended use.

The Contractor shall be responsible for safeguarding stored equipment and materials against loss or damage of any nature whatsoever, shall retain title until incorporated into the work and acceptance by the County and in case of loss or damage, the Contractor shall replace such lost or damaged equipment and materials at no cost to the County.

After receipt of payment, the Contractor shall not remove from the site equipment and materials for which such payment was made without written authorization from the Commissioner.

No major equipment item shall be brought to the site until the following conditions are met:

- 1) The County must have received the manufacture's recommendations for on-site storage in writing.
- 2) The structure in which the equipment is to be installed is roofed (roofing must be watertight) and has such protection of doorways, windows, and other openings that will provide reasonable protection from the weather.
- 3) Prior to the County making a Partial Payment on a major equipment item the following conditions must be met:
 - a. The Contractor must certify to the County, in writing, that the equipment has been properly stored.
 - b. The Shop Drawings must be approved and the draft Operation and Maintenance Manuals must have been submitted.

The Contractor shall furnish to the Construction Administrator, prior to the making up of any Partial or Final Estimate, a copy of its and its Subcontractors' weekly payrolls for each and every preceding payroll period. The payroll submitted shall be a certified true copy and shall contain full information including but not limited to the number of hours worked, rate, classification and total sum paid each employee charged to or working on the job. With all except the first estimate, the Contractor shall furnish to the Construction Administrator a sworn statement listing all unpaid bills and liabilities incurred under the Contract.

A. Substantial Completion Payment

- 1) Within thirty (30) days after receiving written notice from the Contractor of substantial completion of the work under this Agreement, the Commissioner will cause an inspection to be made of the work done under this contract. If, upon such inspection, the Engineer determines that the work is substantially complete, a Substantial Completion Payment to the Contractor for the work done under this Contract, less any and all deductions authorized to be made by the Commissioner under this contract or by law, will be issued.
- 2) Such a Payment shall be considered a Partial and not a Final Payment.
- 3) As a condition precedent to receiving payment therefore, the Contractor must have received County approval of all Shop Drawing submittals, the Operation and Maintenance Manuals, and As-Built Drawing(s). Together with its application for substantial completion payment the Contractor shall also deliver to the

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Construction Administrator a verified statement certifying that all claims or liabilities arising from the completed work, including all charges for Extra Work, Change Orders, additional time, damages or credits (collectively referred to as “claims”) have been presented to the County. All such claims shall be described in sufficient detail so as to be easily identified. The Contractor’s failure to submit the verified statement shall constitute a full and final waiver of all claims against the County from the beginning of the project through the date of substantial completion as established by the County. The presentation of the verified statement to the County shall not constitute an acknowledgement by the County that any such claim is valid. The County expressly reserves its right to assert that any such claim(s) is waived or precluded by reason of other provisions of the contract documents. Only claims particularly identified on the Contractor’s verified statement shall be preserved; all other claims whatever nature shall be deemed waived and released. It shall also submit proof of title of the materials and equipment covered by the contract. The Contractor shall also, prior to the issuance of said Substantial Completion Payment, supply to the County affidavits and certificates for labor, material and equipment (where applicable).

B. Final Payment

- 1) Within ten (10) days after receiving written notice from the Contractor of completion of all the work, the Engineer will make a final inspection. If upon inspection the Engineer determines that no further work is needed, the Commissioner will request that the Board of Acquisition and Contract approve the completion of the project and authorize payment of the Final Estimate. Also required prior to the Board of Acquisition and Contract approval is a Condition Report by the Contractor that any damage of public or privately owned properties resulting from the Contractor’s work has been satisfactorily repaired.
- 2) As a condition precedent to receiving Final Payment therefore the Contractor shall submit a supplementary verified statement similar to that required under, “A. Substantial Completion Payment”, hereof. This verified statement must include only those charges for Extra Work, Change Orders, additional time, damages or credits (collectively referred to as “claims”) that accrued between substantial completion and final completion. The Contractor’s failure to submit the verified statement shall constitute a full and final waiver of all claims against the County from the beginning of the project through the date of substantial completion as established by the County. The presentation of the verified statement to the County shall not constitute an acknowledgement by the County that any such claim is valid. The County expressly reserves its right to assert that any such claim is waived or precluded by reason of other provisions of the contract documents. Only claims particularly identified on the Contractor’s supplementary verified statement shall be preserved; all other claims of whatever nature shall be deemed waived and released.
- 3) The Contractor shall also, prior to the issuance of Final Payment, supply to the County affidavits and certificates for labor, material and equipment (where applicable).

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- 4) The County will, not less than thirty (30) days after the Final Acceptance of the work under this contract, by the Board of Acquisition and Contract, pay the Contractor upon the receipt of all required documentation the balance of funds due thereunder after deduction of all previous payments, liens and all percentages and amounts to be kept and retained under provision of this contract.

All prior Partial Payments, being merely estimates made to enable the Contractor to prosecute the work more advantageously, shall be subject to correction in the Final Estimate and Payment

- 5) The acceptance by the Contractor or by anyone claiming by or through him of the Final Payment shall operate as and shall be a release to the County and every officer and agent thereof, from any and all claims of the Contractor for anything done or furnished in connection with this work or project and for any act or omission of the County or of any others relating to or affecting the work. No payment, however, final or otherwise, shall operate to release the Contractor or its Sureties from any obligation under this contract or the Performance and Payment Bond. Should the Contractor refuse to accept the final payment as tendered by the County, it shall constitute a waiver of any rights to interest thereon. Nor shall refusal to accept final payment extend any applicable statute of limitation.

23. PAYMENTS TO SUBCONTRACTORS AND MATERIALMEN BY CONTRACTOR

Within fifteen calendar days of the receipt of any payment from the County, the contractor shall pay each of its sub-contractors and materialmen the proceeds from the payment representing the value of the work performed and/or materials furnished by the subcontractor and/or materialmen as reflected in the payment from the owner less an amount necessary to satisfy any claims, liens or judgment against the subcontractor or materialman which have not been suitably discharged and less any retained amount as hereafter described. The contractor shall retain not more than five per centum of each payment to the subcontractor and/or materialman except that the contractor may retain in excess of five per centum but not more than ten per centum of each payment to the subcontractor provided that prior to entering into a subcontract with the contractor, the sub-contractor is unable or unwilling to provide a performance bond and a labor and material bond both in the full amount of the sub-contract at the request of the contractor. However, the contractor shall retain nothing from those payments representing proceeds owed the subcontractor and/or materialman from the County's payments to the contractor for the remaining amounts of the contract balance as provided in Article "Estimates and Payments" of the Information For Bidders. Within fifteen calendar days of the receipts of payment from the contractor, the subcontractor and/or materialman shall pay each of its subcontractors and materialmen in the same manner as the contractor has paid the subcontractor.

Nothing provided herein shall create any obligation on the part of the County to pay or to see the payment of any moneys to any subcontractor or materialman from any contractor nor shall anything provided herein serve to create any relationship in contract or otherwise, implied or expressed between the subcontractor or materialman and the County. Notwithstanding anything to the foregoing, the County may tender payments to the Contractor in the form of joint or dual payee checks.

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NOTICE: No direct payment will be made for work done or materials furnished under the General Clauses, Information for Bidders, General Clauses and Special Clauses, except where expressly stated elsewhere, but compensation shall be deemed to be included in the contract lump sum price for the total work and/or the contract unit prices for the various items of the work.

24. TIME OF STARTING

Time being of the essence, all bidders shall take notice that the timely completion of the work called for under this contract is of the greatest importance. The contractor shall commence its work within ten (10) days after "notice to proceed" has been given it by the Commissioner (unless a definite starting date is stated). Prior to commencing its work, the Contractor shall notify the Director of Project Management, Division of Engineering and Department of Public Works, at least forty-eight (48) hours prior to the planned date of its "start", so that a Construction Administrator can be assigned to the work.

25. SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION AND DEMOLITION WORK

At all times the Contractor shall use all required and necessary precautions for the safety and protection of the public, County personnel, construction employees, and private and public property on or adjacent to the work.

The Contractor shall comply fully with all the applicable provisions of the following listed governmental regulations and standards, noting that in case of conflict, the Contractor shall comply with the most stringent rule or regulation:

- 1) State of New York, Department of Labor, Bureau of Standards and Appeals, Industrial Code Rule 23 "Protection of Persons Employed in Construction and Demolition Work."
- 2) United States Department of Labor, Bureau of Labor Standards, "Safety and Health Regulations for Construction," as promulgated in accordance with the Occupational Safety and Health Act of 1970, Public Law 91-596; 84 Stat. 1590, Laws of 91st Congress - 2nd Session.

It shall be the sole responsibility of the Contractor to ascertain which of the regulations and standards contained in the foregoing listed publications effect its construction activities, and it shall be solely responsible for the penalties resulting from its failure to comply with such applicable rules and regulations. Copies of the listed publications are available for reference purposes only, in the Westchester County Department of Public Works, Division of Engineering, Design Section, Room 500, Michaelian Office Building, White Plains, New York.

The West Nile Mosquito control program:

- 1) Routinely, the work site should be inspected for potential habitats (i.e. stagnant/standing water) for mosquitoes.
- 2) Conditions that would require remediation include: improper site grading, ruts/other depressions, water in debris (i.e. containers, tires, etc.), stored or

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discarded materials, and excavations, and those cited by the Construction Administrator.

- 3) Under the direction of the Construction Administrator, the Contractor shall take all necessary preventive and/or corrective action to eliminate the potential breeding grounds.

26. ACCIDENT PREVENTION AND FIRST AID FACILITIES

In addition to conforming to the applicable governmental regulations and standards referred to in Article "Fire Prevention And Control" of the Information For Bidders, the Contractor shall conduct its work in accordance with the recommendations contained in the latest edition of the "Manual of Accident Prevention in Construction," as published by the Associated General Contractors of America, Inc. and the most recent safety codes approved by the American Standards Association. In case of the conflict with the referenced governmental regulations and standards, the most stringent regulation, standard or recommendation shall govern.

Further, and without in any way limiting the Contractor's obligations hereunder, and in accordance with the instructions of the Construction Administrator, the Contractor shall provide barricades, warning lights, danger and caution signs and other safeguards at all places where the work in any way is a hazard to the public.

The Contractor shall also provide and maintain upon the site at each location where major work is in progress, a completely equipped first aid kit that shall be readily accessible when construction activities are in progress. Posted on each first aid kit shall be the name, location and telephone number of the nearest hospital or doctor with whom the Contractor has previously made arrangements for emergency treatment in case of accident.

27. FIRE PREVENTION AND CONTROL

The Contractor shall abide by such rules and instructions as to fire prevention and control as the municipality having jurisdiction may prescribe. It shall take all necessary steps to prevent its employees from setting fires not required in the construction of the facility and shall be responsible for preventing the escape of fires set in connection with the construction.

It shall at all times provide the proper housekeeping to minimize potential fire hazards, and shall provide approved spark arresters on all steam engines, internal combustion engines and fuels.

Free access to fire hydrants and standpipe connections shall be maintained at all times during construction operations, and portable fire extinguishers shall be provided by the Contractor and made conveniently available throughout the construction site. The Contractor shall also notify its employees of the location of the nearest fire alarm box at all locations where work is in progress.

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28. STATE AND LOCAL SALES TAX EXEMPTION

The Contractor's attention is directed to Section 1115 of the Tax Law of New York State, Chapters 513 and 514 of the Laws of 1974. In connection with capital improvement contracts entered into on or after September 1, 1974, all tangible personal property which will become an integral component of a structure, building or real property of New York State, or any of its political sub-divisions, including the County of Westchester, is exempt from State and local retail sales tax and compensating use tax.

Bidders' proposals shall exclude dollar amounts for the payment of State and Local retail sales tax and compensating use tax, for tangible personal property defined above.

The successful bidder shall be obliged to file the required Contractor Exempt Purchase Certificates, which may be obtained from the New York State Department of Taxation and Finance (1-800-462-8100), in order to utilize such exemption.

29. APPRENTICES

The attention of all bidders is directed to Section 220(3-e) of the New York State Labor Law, which is hereby incorporated herein by reference, which requires, among other things, that "Apprentices who are registered under a Bona Fide New York State Registered Apprentice Training Program shall be permitted to work."

30. AFFIRMATIVE ACTION PROVISION

During the performance of this Contract, the Contractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, age or handicap. Contractor shall take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, color, religion, sex, national origin, age or handicap. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoffs or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Contractor agrees to include, or require the inclusion of the above provision in any subcontract made pursuant to its contract with the County.

31. AFFIRMATIVE ACTION PROGRAM REQUIREMENT

Relative to the award of this Contract, it is required that all bidders completely answer all questions contained in the questionnaire entitled "Affirmative Action Program Requirement" of the Proposal Pages, and properly attest to same.

It is also required that all subcontractors completely answer all questions contained in the questionnaire entitled "Affirmative Action Program Requirement-Subcontractors" of the Sample Forms, and properly attest to same. This form is to be submitted with the request to utilize subcontractor(s).

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32. AUTHORITY TO DO BUSINESS IN NEW YORK

Any corporation not incorporated under the Laws of New York State, must furnish a copy of its certificate of authority, from the New York State Secretary of State, to do business in the State of New York, in accordance with Article 13 of the New York State Business Corporation Law.

33. LICENSE REQUIREMENTS (ELECTRICAL)

- A. In accordance with the requirements of Local Law No. 20-1997 of Westchester County, no person shall perform work under any contract with the County of Westchester except (i) a licensed Master Electrician; (ii) a licensed "Special Electrician"; or (iii) a Journeyman Electrician working under the direct supervision and control of a Master Electrician.

In no event shall the County incur any liability to pay for any electrical work performed in violation of the licensing requirements of Local Law No. 20-1997 of Westchester County.

- B. Contract with separate bids:

If the project is one where separate bid specifications are required pursuant to the provisions of the New York General Municipal Law, then any person, partnership, corporation, business organization or other business entity submitting a bid for the electrical portion of the project must possess, at the time of submission of the Bid, a valid Master/"Special" Electrician's license issued by the Westchester County Electrical Licensing Board in accordance with Chapter 277 Article XVII of the Laws of Westchester County and the Westchester County Electrical Licensing Board Rules & Regulations, in particular No. 11, which states as follows:

No individual holding a Master Electrician's License shall lend such License to any person or allow any other person to carry on, engage in, or labor at the business as defined herein of installing, removing, altering, testing, replacing, or repairing electrical systems. A violation of this section by any person holding a License shall be sufficient cause for revocation of such License.

However, nothing herein shall be construed to prohibit the use of a License by the holder thereof for or on behalf of a partnership, corporation or other business association, provided that fifty-one (51) percent or more of the control of the voting capital stock of such partnership, corporation, or other business association is owned by one (1) or more holders of a Westchester County Master Electrical License and that all work performed by such partnership, corporation or other business association is performed by or under the direct supervision of such License holder or holders.

- C. Contract with single bid:

Where the project does not involve separate bids pursuant to the New York General Municipal Law but where some electrical work is contemplated along with other work, the person, firm, partnership or corporation engaged to perform said electrical work

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must possess a valid Master/"Special" Electrician's license issued by the Westchester County Electrical Licensing Board.

- D. An electrical bidder must complete the "Certificate of License (Electrical)" of the Proposal Pages and will be required to furnish a copy of such license with the sealed Bid. Other bidders will be required to furnish a copy of such license for the applicable person engaged to perform the electrical work when request by the County, prior to awarding the contract.
- E. The license must be maintained at all times during the performance of the work contemplated under the contract. The suspension, revocation or the failure to maintain or renew such license shall, in addition to any other right or remedy available to the County, be grounds for immediate termination of the contract, effective immediately upon notice from the Commissioner.

34. LICENSE REQUIREMENTS (PLUMBING)

- A. In accordance with the requirements of Chapter 277, Article XV of the Laws of Westchester County, no person shall perform plumbing work under any contract with the County of Westchester except (i) a licensed Master Plumber; (ii) a certified Journey Level Plumber employed by and under the direction of a licensed Master Plumber; or (iii) an Apprentice Plumber working under the direct supervision and control of a Master Plumber or under the direct supervision and control of a certified Journey Level Plumber in the employ of a licensed Master Plumber.

In no event shall the County incur any liability to pay for any plumbing work performed in violation of the licensing requirements of Chapter 277, Article XV of the Laws of Westchester County.

- B. Contract with separate bids:

If the project is one where separate bid specifications are required pursuant to the provisions of the New York General Municipal Law, then any person, partnership, corporation, business organization or other business entity submitting a bid for the plumbing portion of the project must possess, at the time of submission of the Bid, a valid Master Plumber's license issued by the Westchester County Board of Plumbing Examiners in accordance with the Westchester County Board of Plumbing Examiners Rules and Regulations and Chapter 277 Article XV of the Laws of Westchester County, in particular Section 277.509A, which states as follows:

- A. No holder of a license or certification issued under this article shall authorize, consent to or permit the use of his or her license or certification by or on behalf of any other person. No person who has not qualified or obtained a license or certification under this article shall represent himself or herself to the public as holder of a license or certification issued under this article, either directly, by means of signs, sign cards metal plates or stationery, or indirectly in any other manner whatsoever. However, nothing herein shall be construed to prohibit the use of a license by the holder thereof for or on behalf of a partnership, corporation or other business association, provided that 51 percent or more of the control of the voting capital stock of such partnership, corporation or other business

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association is owned by one or more holders of a Westchester County master plumbing license and that all work performed by such partnership, corporation or other business association is performed by or under the direct supervision of such license holder or holders.

C. Contract with single bid:

Where the project does not involve separate bids pursuant to the New York General Municipal Law but where some plumbing work is contemplated along with other work, the person, firm, partnership or corporation engaged to perform said plumbing work must possess a valid Master Plumber's license issued by the Westchester County Board of Plumbing Examiners.

D. A plumbing bidder must complete the "Certificate of License (Plumbing)" of the Proposal Pages and will be required to furnish a copy of such license and the County issued identity badge with the sealed Bid. Other bidders will be required to furnish a copy of such license and the County issued identity badge for the applicable person engaged to perform the plumbing work when request by the County, prior to awarding the contract.

E. A restricted Master Plumber's license issued by the Westchester County Board of Plumbing Examiners shall satisfy the requirements of this section provided such restricted license authorizes the Master Plumber to engage in the business of plumbing within the local municipality in which the work under the contract is to be performed.

F. The license must be maintained at all times during the performance of the work contemplated under the contract. The suspension, revocation or the failure to maintain or renew such license shall, in addition to any other right or remedy available to the County, be grounds for immediate termination of the contract, effective immediately upon notice from the Commissioner.

35. LICENSE REQUIREMENTS (HAULERS)

(Haulers Of Solid Waste; Recyclables; Construction And Demolition Debris; Garden And Yard Waste And/Or Scrap Metal)

A. DEFINITIONS:

- 1) "Class A" refers to all haulers except those whose hauling business is limited solely to Class C, Class D or Class E activities or whose recycling business is limited to Class B activities. Class A Licensees may also conduct Class B, Class C, Class D and Class E activities.
- 2) "Class B" refers to Recyclable brokers. Class B Licensees may also conduct Class C, Class D and Class E activities.
- 3) "Class C" refers to haulers who exclusively handle construction and demolition debris. Class C Licensees may also conduct Class D and Class E activities. With respect to Class C haulers, the following shall apply: a. Class "C-1" shall refer to a business or subsidiary which generates construction and demolition debris, as defined herein, and which, incidental to such business, transports, stores, processes, transfers or disposes of the construction and demolition debris generated by the

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operations of such business or subsidiary. Class "C-1" Licensees may also conduct Class E activities; b. Class "C-2" shall refer to all other businesses which otherwise transport, collect, store, transfer, process, or dispose of construction and demolition debris. Class "C-2" haulers may also conduct Class "C-1", Class D and Class E activities.

- 4) "Class D" refers to (i) haulers who collect, store, transport, transfer, process or dispose of garden and yard waste generated, originated or brought within the County where such garden and yard waste was previously generated by a person or entity other than the Licensees and/or (ii) haulers who collect, store, transport, transfer, process or dispose of garden and yard waste and which own, lease, or control one or more vehicles having three (3) or more axles which vehicles will be used in the collection, storage, transfer, transportation, processing or disposal of garden and yard waste generated, originated or brought within the County.
- 5) "Class E" refers to haulers who exclusively conduct a scrap peddler business.
- 6) "Construction and Demolition Debris" means uncontaminated Solid Waste resulting from the construction, remodeling, repair and demolition of structures and roads, and uncontaminated Solid Waste consisting of vegetation resulting from land clearing and grubbing, utility line maintenance and seasonal and storm-related cleanup. Such waste includes, but is not limited to, bricks, concrete and other masonry materials, soil, rock, wood, wall coverings, plaster, drywall, plumbing fixtures, non-asbestos insulation, roofing shingles, asphaltic pavement, glass, plastics that are not sealed in a manner that conceals other waste, electrical wiring and components containing no hazardous liquids, metals, and trees or tree limbs that are incidental to any of the above.
- 7) "Hauler" means any person excluding municipalities, the County and any County district including, but not limited to, Refuse Disposal District No. 1 and all County sewer and water districts, who, for a fee or other consideration, collects, stores, processes, transfers, transports or disposes of Solid Waste, Recyclables or construction and demolition debris that is generated or originated within the County or brought within the boundaries of the County for disposal, storage, transfer or processing.
- 8) "Recyclables" means those materials defined as "Recyclables" under Section 825.30 (8) of the Westchester County Source Separation Law.
- 9) "Scrap Peddler" shall mean any person who collects scrap materials for sale to a Recyclable broker using no more than one vehicle for collection and transportation of such materials.
- 10) "Solid Waste" means all putrescible and non-putrescible materials or substances, except as described in Paragraph 4 of 6 NYCRR Part 360-1.2(a), and/or regulated under 6 NYCRR Part 364, that are discarded or rejected as being spent, useless, worthless or in excess to the owners at the time of such discard or rejection including, but not limited to, garbage, refuse, commercial waste, rubbish, ashes, incinerator residue and construction and demolition debris. "Solid Waste" shall not be understood to include Recyclables as defined above.

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- B. **PLEASE TAKE NOTICE** - In accordance with the requirements of Chapter 826-a, Article III of the Laws of Westchester County, it is unlawful for any person to collect, store, transfer, transport or dispose of solid waste; recyclables; construction and demolition debris; garden and yard waste and/or scrap metal, as defined herein, that is generated or originated within the County or brought within the boundaries of the County for disposal, storage, transfer or processing, or to conduct any activities defined as Class A, Class B, Class C, Class D or Class E activities under Chapter 826-a of the Laws of Westchester County, in Westchester County (hereinafter collectively referred to as "hauling") without having first obtained a license therefore from the Westchester County Solid Waste Commission.

In no event shall the County incur any liability with respect to any hauling activities conducted by the bidder or any subcontractor of the bidder in violation of Chapter 826-a of the Laws of Westchester County.

- C. Where the project necessitates that hauling be performed, either the bidder or the person, partnership, corporation, business organization or other business entity engaged to perform such hauling work on behalf of the bidder (hereinafter the "subcontractor") must possess a valid license issued by the Westchester County Solid Waste Commission at the time of submission of the bid and throughout the duration of any contract issued pursuant thereto.
- D. A hauler bidder must complete the "Certificate of License (Hauler)" of the Proposal Pages and will be required to furnish a copy of such license with the sealed bid. Other bidders will be required to furnish a copy of such license for the applicable person engaged to perform the hauling work when requested by the County, prior to awarding the contract.
- E. The suspension, revocation, or the failure to maintain or renew such license may, in addition to any other right or remedy available to the County, be grounds for termination of the contract, effective immediately upon notice from the Commissioner. The bidder which is awarded the contract hereunder shall have a continuing obligation to notify the Commissioner, within (2) business days, of any suspension, revocation or other action taken with respect to any license issued by the Westchester County Solid Waste Commission which may limit or impair the bidder's ability, or the ability of any authorized subcontractor, to perform such hauling work in the County of Westchester.

It shall be the bidder's responsibility to ensure that any subcontractor who will perform the hauling services required under any contract issued pursuant to this bid specification has a valid license for the duration of the term of any contract awarded hereunder.

- F. In the event that a license held by the bidder or its subcontractor is revoked, suspended or otherwise discontinued by the Westchester County Solid Waste Commission, or in the event that the bidder is otherwise required to obtain the services of a new or alternate subcontractor for the hauling work, the bidder shall immediately notify the Commissioner and seek the Commissioner's approval for the use of such subcontractor to provide the hauling services which are required under the contract, and shall provide the Commissioner with a copy of the license issued by the Westchester County Solid Waste Commission to such subcontractor. No bidder or subcontractor shall provide

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hauling services under the contract until a copy of its license has been provided to the Commissioner and the Commissioner has approved of such bidder or subcontractor.

36. MINORITY PARTICIPATION POLICY

- A. Pursuant to Chapter 308 of the Laws of the County of Westchester, the County encourages the meaningful and significant participation of business enterprises owned by persons of color and women - Minority Business Enterprise (MBE) and Women Business Enterprise(WBE); on County of Westchester contracts.
- B. It is the goal of the County of Westchester to use its best efforts to encourage, promote and increase participation of business enterprises owned and controlled by persons of color or women (MBE/WBE) in contracts and projects funded by all departments of the County and to develop a policy to efficiently and effectively monitor such participation.
- C. In recognition of the need to promote the development of business enterprises owned and controlled by persons of color and women to achieve a goal of equal opportunity, and overcome the existing under representation of these groups in the business community, the County of Westchester acting through its Office of Economic Development shall as a lawful public and County purpose provide technical and informational assistance to such business enterprises with a particular emphasis on education programs to encourage participation in the contract procurement process.
- D. For the purposes of this Local Law, a business enterprise owned and controlled by women or persons of color shall be construed to mean a business enterprise including a sole proprietorship, partnership or corporation that is: (a) at least 51% owned by one or more persons of color or women; (b) an enterprise in which such ownership by persons of color or women is real, substantial and continuing; (c) an enterprise in which such ownership interest by persons of color or women has and exercises the authority to control and operate, independently, the day-to-day business decisions of the enterprise; and (d) an enterprise authorized to do business in this state which is independently owned and operated. In addition, a business enterprise owned and controlled by persons of color or women shall be deemed to include any business enterprise certified as an MBE or WBE pursuant to Article 15-a of the New York State Executive Law and implementing regulations, 9 NYCRR Subtitle N Part 540 et seq., or as a small disadvantaged business concern pursuant to the Small Business Act, 15 U.S.C. 631 et seq., and the relevant provisions of the Code of Federal Regulations as amended.
- E. The Contractor hereby acknowledges and agrees:
 - 1) That in the hiring of employees for the performance of work under this contract or any subcontract hereunder, no contractor, subcontractor, nor any person acting on behalf of such contractor or subcontractor, shall be reason of race, creed, color, religion, gender, age, ethnicity, disability, sex, alienage or citizenship status, national origin, marital status, sexual orientation, familial status, genetic predisposition or carrier status discriminate against any citizen of the State of New York who is qualified and available to perform the work to which the employment relates;

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- 2) That no contractor, subcontractor, nor any person on its behalf shall, in any manner, discriminate against or intimidate any employee hired for the performance of work under this contract on account of race, creed, color, religion, gender, age, ethnicity, disability, sex, alienage or citizenship status, national origin, marital status, sexual orientation, familial status, genetic predisposition or carrier status;
 - 3) That there may be deducted from the amount payable to the contractor by the County under this contract a penalty of fifty (50) dollars for each person for each calendar day during which such person was discriminated against or intimidated in violation of the provisions of the contract;
 - 4) That this contract may be canceled or terminated by the County, and all moneys due or to become due hereunder may be forfeited, for a second or any subsequent violation of the terms or conditions of this section of the contract; and
 - 5) The aforesaid provisions of this section covering every contract for or on behalf of the County for the manufacture, sale or distribution of materials, equipment or supplies shall be limited to operations performed within the territorial limits of the State of New York.
 - 6) Contractor agrees to include, or require the inclusion of the above provision in any subcontract made pursuant to its contract with the County.
- F. In furtherance of the Contractor's obligation to make documented good faith efforts to utilize Minority Business Enterprises (MBE) and Women's Business Enterprises (WBE) for the Work required by this Contract, the Contractor shall provide the Minority/Women Business Enterprise Questionnaire signed by an officer of the Contractor, and any additional information requested by the County, including but not limited to the following, which shall be delivered to the Construction Administrator and _____, Program Manager of Minority- and Women-Owned Business Program, County of Westchester, Room 911, 148 Martine Avenue, White Plains, New York 10601 coincident with the Contractor's delivery to the County of its bid and shall be provided by the Contractor with any request for approval of subcontractors:
- 1 (a) The name, address, telephone number and contact person of each MBE and WBE solicited verbally by Contractor during the applicable period for the performance of any portion of the Contractor's Work and the date(s) that each such solicitation was made;
 - 1 (b) A description of the portion of the Contractor's Work for which each such solicitation is made.
 - 1 (c) A listing of the project documents, if any, furnished to each such MBE and WBE.
 2. A copy of each written solicitation sent by the Contractor to each MBE and WBE and the name and address of each MBE and WBE to whom the solicitation was made.
 - 3) The name and address of each MBE and WBE that performs any portion of the Contractor's Work, a description of such portion of the Work and the dollar

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amount therefore.

- 4) A statement that the Contractor reviewed a list of MBE and WBE contractors in their outreach efforts. A list can be found at www.westchestergov.com/mwob.
- 5) Indicate those MBE and WBE contractors found on the list that provided the type of subcontractor services required for this project. If none were found, please indicate.
- 6) Describe other outreach efforts, including other MBE and/or WBE lists, organizations or individuals that were contacted.

The failure of the low bidder to comply with the provisions of this subparagraph F may result in the County NOT awarding this contract to your firm. Failure of the Contractor to comply with the provisions of this subparagraph F may constitute a material breach of this Contract. Failure to comply with the Minority Participation Policy may be considered by the County when awarding contracts.

37. SEXUAL HARASSMENT POLICY

- A. As with discrimination involving race, color, religion, age, sexual orientation, disability, and national origin, Westchester County also prohibits sex discrimination, including sexual harassment of its employees in any form. The County will take all steps necessary to prevent and stop the occurrence of sexual harassment in the workplace.
 - 1) **This policy applies to all County employees and all personnel in a contractual relationship with the County.** Depending on the extent of the County's exercise of control, this policy may be applied to the conduct of non-County employees with respect to sexual harassment of County employees in the workplace.
 - 2) This sexual harassment policy includes, but is not limited to, inappropriate forms of behavior described by the Equal Employment Opportunity Commission.
- B. Sexual advances that are not welcome, requests for sexual favors, and other verbal or physical conduct of a sexual nature constitutes sexual harassment when:
 - 1) Submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment; -OR-
 - 2) Submission to or rejection of such conduct by an individual is used as the basis for employment decisions, such as promotion, transfer, or termination, affecting such individuals; -OR-
 - 3) Such conduct has the purpose or effect of unreasonably interfering with an individual's work performance or creating an intimidating, hostile or offensive working environment.
- C. Sexual harassment refers to behavior that is not welcome, that is personally offensive, that fails to respect the rights of others, that lowers morale and that, therefore, interferes

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with an employee's work performance and effectiveness or creates an intimidating, hostile or offensive working environment.

38. SMOKE-FREE WORKPLACE POLICY

- A. By way of Executive Order No. 5 of 1998 and Local Law 3 of 2003, it is now the policy of the County of Westchester to institute a smoke-free “workplace”.
- B. Every indoor County “workplace”, shall become a smoke-free area. The smoking or carrying of lighted cigarettes, cigars, pipes, or any other tobacco-based products, or products that result in smoke, is hereby banned.
- C. Every indoor County “workplace” shall be covered under this Executive Order, including the County Jail in Valhalla and the Westchester County Center in White Plains. This Executive Order shall not, however, apply to County-owned facilities that are not County “workplaces”, such as employees housing or privately run restaurants on County property (e.g. at the County golf courses).
- D. The Richard J. Daronco County Courthouse shall not, for purposes of this Executive Order, be considered a County “workplace”, and therefore shall not be required to be smoke-free.
- E. This Executive Order is intended to be consistent with, and not modify, any provisions of the New York State Public Health Law.
- F. This Executive Order shall take effect immediately and remain in full force and effect until otherwise superseded or revoked.

39. COUNTY ENERGY EFFICIENT PURCHASING POLICY

- A. By way of Executive Order No. 9 of 2002, it is now the policy of the County of Westchester to institute an Energy Efficient Purchasing Policy.
- B. This policy shall apply to all purchases made by and for the County in accordance with applicable laws, rules and regulations.
- C. Wherever the price is reasonably competitive and the quality adequate for the purpose intended, purchase and utilization of products that meet Energy Star requirements for energy efficiency as determined by the United States Environmental Protection Agency and the United States Department of Energy is hereby recommended.
- D. If the Energy Star label is not available with respect to a particular product, than it is recommended that products in the upper twenty-five percent of energy efficiency as designated by the United States Federal Energy Management Program shall be purchased and utilized if the prices of those products are reasonably competitive and the quality adequate for the purpose intended.

40. RESTRICTION ON USE OF TROPICAL HARDWOODS

- A. The bidder/proposer shall not use or propose to use any tropical hardwoods or tropical hardwood products in any form, except in accordance with State Finance Law § 165 (Use of Tropical Hardwoods), as may be amended from time to time. Pursuant to the

INFORMATION FOR BIDDERS

State Finance Law § 165, any bid/proposal which proposes or calls for the use of any tropical hardwood or wood product in the performance of the contract shall be deemed non-responsive.

41. DISCLOSURE OF RELATIONSHIPS TO COUNTY

- A. The successful bidder is required to complete the form entitled “Required Disclosure of Relationships to County” on Proposal Pages 32-33 before award of the contract.
- B. In the event that any information provided on the completed Proposal Pages entitled “Required Disclosure of Relationships to County” changes during the term of this agreement, the Contractor shall notify the Commissioner in writing within ten (10) days of such event by submitting a revised “Required Disclosure of Relationships to County” form.

42. CONTRACTOR DISCLOSURE STATEMENT

The Contractor and each Major Subcontractor represents that all information provided by the Contractor and Major Subcontractor in the form entitled “Contractor Disclosure Statement” on Proposal Pages 23-31 is in all respects true and correct. In the event the information provided on that document changes during the term of this agreement or for a period of three (3) years after the date that the Contractor and/or the Major Subcontractor receives final payment under this agreement, the Contractor and/or Major Subcontractor shall notify the Commissioner in writing within ten (10) days of such event by submitting a revised “Contractor/Major Subcontractor Disclosure Statement”. Bidders must complete the Required Disclosure of Relationships to County form. The Required Disclosure of Relationships to County form is located on Proposal Pages 32-33.

43. CRIMINAL BACKGROUND INFORMATION

Pursuant to Executive Order 1-2008 and subject to the applicable provisions of New York Correction Law §§ 752 and 753, the County shall have the right to bar the following “Persons Subject to Disclosure” (Persons shall mean individuals or legal entities) from providing work or services to the County or from being on County property:

(a) Consultants, Contractors, Licensees, Lessees of County owned real property, their principals, agents, employees, volunteers or any other person acting on behalf of said Contractor, Consultant, Licensee, or Lessee who is at least sixteen (16) years old, including but not limited to Subconsultants, Subcontractors, Sublessees or Sublicensees who are providing services to the County; and

(b) Any family member or other person, who is at least sixteen (16) years old, residing in the household of a County employee who lives in housing provided by the County located on County property.

If any of the above mentioned Persons Subject to Disclosure has either one of the following:

(a) A conviction of a crime (all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State);

(b) A pending criminal proceeding for a crime(s) as defined above; or

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(c) A refusal to answer such questions.

Where the following criteria apply:

(a) If any of the Persons Subject to Disclosure providing work or services to the County in relation to a County Contract are not subject to constant monitoring by County staff while performing tasks and/or while such persons are present on County property pursuant to the County Contract; and

(b) If any of the Persons Subject to Disclosure providing work or services to the County, in relation to a County Contract may, in the course of providing those services, have access to sensitive data (for example, Social Security Numbers and other personal/secure data); facilities (secure facilities and/or communication equipment); and/or vulnerable populations (for example, children, seniors and the infirm).

Accordingly, the Contractor is required to review the Instructions found in the instructions and complete “Contractor and all persons subject to Disclosure Certification Forms” located at Forms Pages 11-13 as well as any other applicable criminal disclosure forms (i.e., Forms Pages 14 through 19,” together with Forms Pages 11-13 collectively referred to as “Disclosure Forms”).

However, the following Persons Subject to Disclosure are **exempt** from Executive Order 1-2008: (i) those persons for whom the County has already conducted a background check and issued a security clearance that is in full force and effect; or (ii) those persons for whom another state or federal agency having appropriate jurisdiction has conducted a security and/or background clearance or has implemented other protocols or criteria for this purpose that apply to the subject matter of this Contract that is in full force and effect.

If a Person Subject to Disclosure is exempt from the disclosure described in Executive Order 1-2008 because of either “i” or “ii” above, then the Contractor shall notify the Procuring Officer¹ in the respective Department of its claim of exemption and it shall be the responsibility of the Procuring Officer to verify each exemption. If the Procuring Officer determines that the Contractor is exempt under sections “i” or “ii” above, the Procuring Officer shall confirm same with the Contractor and maintain a written record including all supporting details of the verification of and acknowledgement of said exemption.

If the Procuring Officer determines that the Contractor is not exempt under sections “i” or “ii” above, the Procuring Officer shall notify the Contractor in writing, and the appropriate Disclosure Forms shall be required.

It shall be the Contractor’s duty to disclose and to inquire of each and every Person Subject to Disclosure, whether they have been convicted of a crime or whether they are currently subject to pending criminal charges. It shall be the duty of the Contractor to submit a completed Certification Form “Forms Pages 11-13”annexed hereto as ,” which certifies that the Contractor and every Person Subject to Disclosure has been asked whether they have been convicted of a crime or are currently subject to pending criminal charges.

Should the Contractor or any Person Subject to Disclosure (also referred to as “Person”)

¹ “Procuring Officer” shall mean the head of the department or the individual(s) authorized by the head(s) of the department(s) undertaking the procurement and with respect to those matters delegated to the Bureau of Purchase and Supply pursuant to Section 161.11(a) of the Laws of Westchester County, the Purchasing Agent.

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affirmatively advise that they have been convicted of a crime said Person shall be identified in Forms Page 14 entitled “Names And Titles Of Persons Subject To Disclosure That Answered Yes” to any questions on Forms Pages 11-13 and shall complete Forms Pages 15-16 entitled, “Criminal Background Disclosure Form For Persons Who Have Been Convicted of A Crime.”

Should the Contractor or any Person Subject to Disclosure advise that they are subject to pending criminal charges, said Person shall be identified in Forms Page 14 and shall complete the form annexed hereto as Forms Pages 17-18 entitled, “Criminal Background Disclosure Form For Persons Who Are Subject to Pending Criminal Charges.”

Should the Contractor or any Person Subject to Disclosure refuse to answer whether they have been convicted of a crime or are currently subject to pending criminal charges, the name and title of said Person(s) shall be listed on Forms Page 19 entitled “Persons That refused To Answer”.

It shall be the duty of the Contractor to submit to the Procuring Officer all of the attached applicable Disclosure Forms prior to the commencement of this Contract. It is the responsibility of each Contractor to assure that all of their proposed Subcontractors complete the criminal background and disclosure certification forms and submit the forms to the Procuring Officer before they will be approved to perform work on the contract.

Under no circumstances shall the existence of a language barrier serve as a basis for the waiver of or an exception to this obligation. If the Contractor needs to obtain translation services to fulfill this obligation, it shall be at the sole cost and expense of the Contractor.

The Contractor shall be required to make the same inquiry and forward updated Disclosure Forms to the Procuring Officer regarding additional Persons Subject to Disclosure in connection with this Contract during the term of this Contract. **NO NEW PERSON SUBJECT TO DISCLOSURE SHALL PERFORM WORK OR SERVICES OR ENTER ONTO COUNTY PREMISES UNTIL THE UPDATED DISCLOSURE FORMS ARE FILED WITH THE PROCURING OFFICER.**

THE CONTRACTOR HAS A CONTINUING OBLIGATION TO MAINTAIN THE ACCURACY OF THE DISCLOSURE FORMS FOR THE DURATION OF THIS CONTRACT, INCLUDING ANY AMENDMENTS OR EXTENSIONS THERETO AND SHALL PROVIDE ANY UPDATES TO THE PROCURING OFFICER AS NECESSARY TO COMPLY WITH THE DISCLOSURE REQUIREMENTS BY EXECUTIVE ORDER 1-2008.

Any failure by the Contractor to comply with the disclosure requirements of Executive Order 1-2008, absent proof of exemption deemed satisfactory by the County Procuring Officer, may be considered by the County, a material breach by the Contractor and may be grounds for immediate termination of this Agreement by the County.

44. MANDATORY OSHA CONSTRUCTION SAFETY AND HEALTH TRAINING

Pursuant to NYS Labor Law §220-h – On all public work projects of at least \$250,000 all laborers, workers and mechanics employed, in the performance of the contract on the public work site, either by the contractor, sub-contractor or other person doing or contracting to do the

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whole or a part of the work contemplated by the contract, are required to be certified as having successfully completed an OSHA construction safety and health course of at least 10 hours prior to performing any work on the project.



3. GENERAL CLAUSES

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

GENERAL CLAUSES

1. MATERIAL AND WORKMANSHIP

It is the intent of these specifications to require first-class work and new and best quality materials. For any unexpected features arising during the progress of the work and not fully covered herein the specifications shall be interpreted to require first-class work and materials, and such interpretations shall be binding upon the Contractor.

- 1) Upon award of the Contract, the Contractor shall furnish in writing to the Construction Administrator the sources of supply for concrete, and other materials that it proposes to use in the work, and material shall not be furnished from other sources of supply except after written approval by the Construction Administrator. The Contractor shall, before ordering equipment verify that Suppliers of equipment will provide the required warranties, guarantees, and maintenance services.

2. DEFINITIONS

COMMISSIONER - The head of the Department of Public Works of the County of Westchester.

CONSTRUCTION ADMINISTRATOR- The representative of the Commissioner of Public Works at the project site who, unless specifically designated otherwise in the Contract, shall in the first instance, make such determinations as are necessary for the expeditious completion of the Work, except for those determinations that are reserved to the Commissioner.

CONTRACT - Shall mean each of the various parts of these documents both as a whole or severally and except for titles, subtitles, headings and table of contents, shall include the Notice to Bidders, Information for Bidders, the Proposal, the Specifications, the Performance Bond, the Plans, the Contract Form, and all addenda and provisions required by law.

CONTRACTOR - Party of the second part to the Contract acting directly or through its agents, subcontractors, or employees, and who is responsible for all debts pertaining to and for the acceptable performance of the work for which it had contracted.

COUNTY - Party of the first part to the Contract as represented by the Board of Acquisition and Contract and the Commissioner of Public Works for the County of Westchester.

ENGINEER - An Engineer or Architect that designed the project and is serving as the duly authorized representative of the Commissioner of Public Works who, in addition to the duties set forth in the Contract, shall, in the first instance, make such determinations as are necessary to ensure the Contractor's compliance with its obligations for the preparation and submission of shop drawings and all other submittals required for the Work. If there is no Engineer the duties of the Engineer shall be performed by the Construction Administrator and all references in this

GENERAL CLAUSES

Agreement to the Engineer shall be deemed to mean the Construction Administrator.

MAJOR SUBCONTRACTOR- Subcontractors performing all or a portion of the work for Electrical; Heating, Ventilating and Air Conditioning; Fire Prevention; General Construction; and/or any Subcontractor whose subcontract price is equal to or greater than ten percent (10%) of the Contract Price.

OWNER - The County of Westchester.

PLANS - All official drawings or reproductions of drawings pertaining to the work or to any structure connected therewith.

SPECIFICATIONS - The body of directions, requirements, etc. contained in this present volume, together with all documents of any descriptions and agreements made (or to be made), pertaining to the methods(or manner) of performing the work or to the quantities and quality. Specifications shall also include the Notice to Contractors, Instructions to Bidders, Bond, Proposal and Contract Agreement.

SURETY - The corporate body, which is bound with and for the Contractor and which engages to be responsible for the faithful performance of the contract, and to indemnify the County against all claims for damages.

A.A.S.H.O. - American Association of State Highway Officials

A.R.E.A. - American Railway Engineering Association

A.S.T.M. - American Society for Testing Materials

A.W.W.A. - American Water Works Association

N.E.C. - National Electrical Code

N.E.M.A. - National Electric Manufacturers Association

3. BOUNDARIES OF WORK

The County will provide land or rights-of-way for the work specified in this Contract. Other contractors, employees or concessionaires of the county, may for all necessary purposes enter upon the work and premises used by the Contractor, and the Contractor shall give to other contractors and employees of the County all reasonable facilities and assistance for the completion of adjoining work.

4. OVERLAPPING WORK

The Contractor shall take notice that because of work on other contracts within and adjacent to the contract limits it may not have exclusive occupancy of the territory within or adjacent

GENERAL CLAUSES

to the contract limits, and that during the life of this contract the owners and operators of Public Utilities may make changes in their facilities.

The said changes may be made by utility employees or by contract within or adjacent to the contract limits and may be both temporary and permanent.

The Contractor shall cooperate with other Contractors and owners of various utilities and shall coordinate and arrange the sequence of its work to conform with the progressive operations of work already or to be put under contract. Cooperation with Contractors already or to be engaged upon the site is essential to properly coordinate the construction efforts of all Contractors, Utility Owners and Subcontractors engaged in work within and adjacent to the contract limits.

The Contractor shall coordinate the work of its various Subcontractors. Their respective operations shall be arranged and conducted so that delays are avoided. Where the work of the Contractor or Subcontractor overlaps or dovetails with that of other Contractors, materials shall be delivered and operations conducted so as to carry on the work continuously in an efficient and workmanlike manner. The Contractor shall coordinate its work to be done hereunder with the work of the other Contractor(s) and the Contractor shall fully cooperate with such other Contractor(s) and carefully fit its own work to that provided under other contracts as may be directed by the Construction Administrator. If the Construction Administrator shall determine that the Contractor is failing to coordinate its work with the work of the other Contractor(s) as the Construction Administrator has directed, then the Commissioner shall have the right, at its sole option, to withhold any payments otherwise due hereunder until the Construction Administrator's directions are complied with by the Contractor and/or deduct the costs incurred by the County due to the Contractor's failure or refusal to so cooperate. Delays or oversights on the part of the Contractor or Subcontractors or Utility Owners in performing their work in the proper manner thereby causing cutting, removing and replacing work already in place, shall not be the basis for a claim for extra compensation.

In the event of interference between operations of Utility Owners and other Contractors, or among the Contractors themselves, the Construction Administrator shall be the sole judge of the rights of each Contractor insofar as the sequence of work necessary to expedite the completion of the entire project, and in all cases its decision shall be final. The Contractor agrees that it has included in its unit prices bid for the various items of the contract the possible additional cost of performing the work under this contract because it may not have a clear site for its work and because of possible interference of roadway use, other Contractors and necessary utility work, and the necessity or desirability of opening certain sections of pavement to traffic before the entire work is completed. The County shall not be liable for any damages suffered by any Contractor by reason of another Contractor's failure to comply with the directions of the Construction Administrator, or by reason of another Contractor's default in performance or by any act or failure to act of any Utility Owner or anyone working on its behalf, it being understood that the County does not guarantee the responsibility or continued efficiency of any Contractor or Utility Owner and under no circumstances shall the County be liable to any Contractor or Utility Owner for any delays, interferences or any other impediment or hindrance to the Contractor's or Utility Owner's work .

GENERAL CLAUSES

Should the Contractor sustain any damage through any act or omission of any other contractor having a Contract with the County for the performance of work upon the site or of work which may be necessary to be performed for the proper prosecution of the work to be performed hereunder, or through any act or omission of a supplier or subcontractor of whatever tier of such contractor, the Contractor shall have no claim against the County for such damage, but shall have a right to recover such damage from the other contractor under the provision similar to the following provision that has been or will be inserted in the Contracts with such other contractors.

Should any other Contractor having or who shall hereafter have a Contract with the County for the performance of work upon the site sustain any damage through any act or omission of the Contractor hereunder or through the act or omission of any subcontractor of whatever tier of the Contractor, the Contractor agrees to reimburse such other Contractor for all such damages and to defend at his own expense any suit based upon such claim and if any judgment or claims against the County shall be allowed the Contractor shall pay or satisfy such judgment or claim and pay all costs and expenses, including attorney's fees, incurred by the County in connection therewith and to indemnify and hold the County harmless from all such claims.

The County's right to indemnification hereunder shall not be diminished or waived by its assessment against the Contractor of liquidated damages as may be provided elsewhere herein.

Delays in availability of any part of the site or any delays due to interference between the several Contractors and the Utility Owners shall be compensated for by the Construction Administrator solely through granting an extension of time in which to complete the work of the contract without assessment of Engineering charges. The Contractor in submitting its bid hereby agrees that it shall make no other claim against the County for any damages due to such delays or interference.

5. PROPER METHOD OF WORK AND PROPER MATERIALS

The Construction Administrator shall have the power in general to direct the order and sequence of the work, which will be such as to permit the entire work under this contract to be begun and to proceed as rapidly as possible, and such as to bring the several parts of the work to a successful completion at about the same time.

If at any time before the commencement or during the progress of the work the materials and appliances used or to be used appear to the Construction Administrator as insufficient or improper for securing the quality of work required, or the required rate of progress, he may order the Contractor to increase their efficiency or to improve their character, and the Contractor shall promptly conform to such order; but the failure of the Construction Administrator to demand any increase of such efficiency or improvement shall not release the Contractor from its obligation to secure the quality of work or the rate of progress specified.

GENERAL CLAUSES

6. CONTROL OF AREA

Unloading of materials and parking of equipment shall be subject to the orders of the Construction Administrator so far as he may find necessary for the protection and safety of the traveling public and the preservation of property.

7. PERMITS, FEES, ETC.

The County will obtain at its sole cost the necessary New York State Pollutant Discharge Elimination System (“SPDES”) Permit and will sign the associated Notice of Intent (“NOI”). The Contractor and its subcontractors will sign the required Certification Statement (a copy of which is contained as Proposal Page) when it signs the contract.

All necessary permits from County, State or other concerned Public Authorities shall be secured at the cost and expense of the Contractor. It shall also give all notices required by law, ordinance, or the rules and regulations of the concerned Public Bureaus or Departments, and also as a part of the Contract, comply without extra charge or compensation with all State Laws and all other Ordinances or Regulations that may be applicable to this work. Contractor, however, shall first notify the Commissioner before proceeding with securing of all necessary permits and the giving of required notices.

8. TRAFFIC

The General Contractor shall be responsible for the Maintenance and Protection of traffic at all times until the date of completion and acceptance of its work.

During the whole course of the work the Contractor shall so conduct its work and operations so as to interfere with traffic passing the work as little as possible and effect by every reasonable means the safety and comfort of pedestrians, vehicles and vehicle passengers passing the work.

9. INSPECTION

The Contractor shall at all times provide convenient access and safe and proper facilities for the inspection of all parts of the work. No work, except such shop work as may be so permitted, shall be done except in the presence of the Construction Administrator or his/her assistants. No material of any kind shall be used upon the work until it has been inspected and accepted by the Construction Administrator. All materials rejected shall be immediately removed from the work and not again offered for inspection. Any materials or workmanship found at any time to be defective shall be remedied at once, regardless of previous inspection. The inspection and supervision of the work by the Construction Administrator is intended to aid the Contractor in supplying labor and materials in accordance with the specifications, but such inspection shall not operate to release the Contractor from any of its contract obligations.

10. STOPPING WORK

The Commissioner, Construction Administrator or Engineer may stop by written order any work or any part of the work under this contract if, in his/her opinion, the methods employed

GENERAL CLAUSES

or conditions are such that unsatisfactory work might result. When work is so stopped it shall not be resumed until the methods or conditions are revised to the satisfaction of the Commissioner, which must be signified in writing. The Contractor agrees to make no claim for increased costs arising from the issuance of any stop work order.

11. DIMENSIONS

Figured dimensions on the plans shall be given preference over scaled dimensions, but shall be checked by the Contractor before starting construction. Any errors, omissions or discrepancies shall be brought to the attention of the Engineer and his/her decision thereon shall be final.

12. PAYMENTS TO COUNTY

Wherever in the Contract Documents the Contractor is required to make a payment to the County, the Contractor agrees that the County has the option to withhold such sum(s) from payments otherwise due to the Contractor and that all such sums withheld shall be deemed not to be earned by the Contractor.

13. PROTECTION OF UTILITIES AND STRUCTURES

The Contractor shall be responsible for the preservation of all public and private underground and surface utilities/structures at or adjacent to the construction work; insofar as they may be endangered by the work. This shall hold true whether or not they are shown on the contract drawings. If they are shown on the drawings, the County does not guarantee their locations even though the information will be from the best available sources.

The Contractor shall give ample and reasonable notice to all private, corporate or municipal owners before work is done near their utility or structure; shall properly protect all utilities/structures encountered; shall at their expense repair/replace any items that are damaged; and shall proceed with caution to prevent undue interruptions to utility services.

Investigation and/or on-site mark-out, by the County, must be done prior to excavation work at the Valhalla Campus. This investigation/mark-out is to serve as a guide for the Contractor and does not absolve the Contractor from the responsibility to repair/replace identified or non-identified utilities/structures, at no cost to the County.

All excavation work performed at the Valhalla Campus requires the submission of a completed "Ground Penetration" form/sketch(es) will be distributed to the appropriate utility owners. Therefore, the Contractor should assume that no excavation work can be performed until approximately twenty (20) working days after submission of the form/sketch(es), but not prior to approval by the DPW-BO Superintendent of Buildings.

14. PROTECTION OF WATER RESOURCES & THE ENVIRONMENT

The Contractor is responsible to review the specifications and drawings as they relate to this Agreement to ascertain what procedures must be followed in order to comply with all applicable stormwater management, water quality control, erosion, and sediment control

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laws, rules, regulations and permits. If the Contractor is of the opinion that any work required, necessitated, or contained in the specifications or otherwise ordered conflicts with the applicable stormwater management, water quality control, erosion, and sediment control laws, rules, regulations, procedures, and permits, including, without limitation, all applicable provisions of the New York State Stormwater Management Design Manual, and the New York Standards and Specifications for Erosion and Sediment Control as they may be amended from time to time, it must promptly notify the First Deputy Commissioner of the Department of Public Works in writing.

In addition to all other requirements contained in this Agreement, the Contractor recognizes and understands that it is an essential element of this Agreement that the Contractor complies with the County's policies to protect water resources and the environment. The Contractor must comply with all applicable stormwater management, water quality control, erosion, and sediment control laws, rules, regulations, permits, procedures and specifications, including, without limitation, all applicable provisions of the New York State Stormwater Management Design Manual,¹ the New York Standards and Specifications for Erosion and Sediment Control as they may be amended from time to time. All of these documents should be obtained from the New York State Department of Environmental Conservation to ensure that the Contractor has the latest version. It should be noted that the standards set forth in the New York State Stormwater Management Design Manual, and the New York Standards and Specifications for Erosion and Sediment Control apply to ALL work done for the County, regardless of the size of the project. In case of a conflict among the governmental regulations and standards, the most stringent regulation, standard or recommendation shall apply to the work done under this Agreement.

The Contractor and its subcontractors shall execute the required Stormwater Pollution Prevention Certification, which is located at Proposal Page 20. In addition, the Contractor acknowledges that if the work required under this Agreement requires that a State Pollutant Discharge Elimination System ("SPDES") permit be obtained from the New York State Department of Environmental Conservation, then the Contractor must comply with the terms and conditions of the SPDES permit for stormwater discharges from construction activities and the Contractor will not take any action or fail to take any necessary action that will result in the County being held to be in violation of said permit or any other permit. The Contractor shall cooperate with the County in obtaining the permit and comply with the SPDES permit and all other applicable laws, rules, regulations and permits.

The Contractor shall provide, as the Commissioner or his designee may request, proof of compliance with the County's policies to protect water resources and the environment, and all applicable stormwater management, water quality control, erosion and sediment control laws, rules, regulations, permits, procedures and specifications.

The Contractor is responsible to ascertain which of the laws, rules, regulations, permits and standards referenced above affect its construction activities, and the Contractor shall be solely responsible for all costs and expenses, including any penalties or fines, incurred by the County, due to the Contractor's failure to comply with such applicable laws, rules,

¹ available at <http://www.dec.state.ny.us/website/dow/swmanual/swmanual.html> - The location of this reference is provided to assist the Contractor; it does not relieve the Contractor from the obligation of obtaining and complying with the latest version of the document.

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permits, regulations, standards and County policies. The Contractor shall be responsible to defend and indemnify the County from any and all claims resulting from the Contractor's failure to comply with the applicable laws, rules, regulations, permits, standards and County policies.

Failure of the Contractor to comply with the County's policies to protect water resources and the environment, and all applicable stormwater management, water quality control, erosion and sediment control laws, rules, regulations, permits, procedures and specifications may result in the withholding of progress payments to the Contractor by the County. Such withholding of progress payments shall not relieve the Contractor of any requirements of the Agreement including the completion of the work within the specified time, and any construction sequence requirement of the Agreement.

The Contractor acknowledges that its failure to comply with the County's policies to protect water resources and the environment, and all applicable stormwater management, water quality control, erosion and sediment control laws, rules, regulations, permits, procedures and specifications shall constitute a material breach under this contract. For the breach or violation of this provision, without limiting any other rights or remedies to which the County may be entitled, the County shall have the right, in its sole discretion to suspend, discontinue or terminate this Agreement immediately upon notice to the Contractor. In such event, the Contractor shall be liable to the County for any additional costs incurred by the County in the completion of the project.

The failure of the Contractor to comply with these requirements could lead to a determination that the Contractor is not a responsible bidder when the Contractor is bidding on other projects.

15. SANITARY REGULATIONS

The Contractor shall obey and enforce such sanitary regulations and orders and shall take such precautions against infectious diseases as may be deemed necessary. The building of shanties or other structures for housing the men, tools, machinery or supplies will be permitted only at approved places, and the sanitary condition of the grounds in and at such shanties or other structures must be at all times maintained in a satisfactory manner.

16. CLEANING UP

Upon completion of the work, the Contractor shall remove all equipment, rubbish, debris and surplus materials from the buildings, and grounds, and provide a suitable dumping place for such materials. The premises shall be left in a neat, clean and acceptable condition.

No litter, debris of any kind shall be allowed to accumulate for more than one day in any portion of the buildings or grounds, and must be removed from the area at the end of each workday.

17. PREVENTION OF DUST HAZARD

In accordance with the New York State Labor Law, Section 22a, in the event a silica or other harmful dust hazard is created due to construction operations under the contract, the Contractor shall install, maintain and keep in effective operation the appliances and methods

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for the elimination of such silica dust or other harmful dust as have been recommended and approved by State and local authorities.

18. REPRESENTATIVE ALWAYS PRESENT

The Contractor in case of its absence from the work shall have a competent representative **fluent in English** or foreman present, who shall obey without delay, all instructions of the Construction Administrator in the prosecution and completion of the work in conformity with this contract, and shall have full authority to supply labor and material immediately.

19. WORK IN BAD WEATHER

During freezing, stormy or inclement weather, no work shall be done except such as can be done satisfactorily and in a manner to secure first-class construction throughout.

20. PROTECTION OF WORK UNTIL COMPLETION

The Contractor shall be responsible for the protection and maintenance of its work until the same has been accepted by the Owner and shall make good any damage to the work caused by floods, storms, settlements, accidents, or acts of negligence by its employees or others so that the complete work when turned over to the Owner will be in first-class condition and in accordance with the plans and specifications.

21. REMOVAL OF TEMPORARY STRUCTURES AND CLEANING UP

On or before the completion of the work the Contractor shall, without charge therefore, tear down and remove all buildings and other structures built by him for facilitating the carrying out of the work, shall remove all rubbish of all kinds from the grounds which he has occupied, shall do any small amount of additional trimming and grading and shall leave the entire work and premises clean, neat and in good condition. The Contractor shall provide at its own expense suitable dumping places for such material. When the necessity for protecting traffic ends, the Contractor shall remove all signs, lighting devices, barricades and temporary railings from the site of the work.

22. GROSS LOADS HAULED ON HIGHWAY

The Contractor shall at no time during the construction of this contract, haul gross loads exceeding the legal limit prescribed by the Highway Law over the highways of access to, or the highway included in this contract.

23. CONCRETE BATCH PROPORTIONS - YIELD

No Construction Administrator or Engineer is authorized to instruct or inform the Contractor, or any of its agents or employees, or its concrete supplier as to the weights of the ingredients to be used to produce a cubic yard of concrete or as to the yield to be used to produce a cubic yard of concrete or as to the yield to be expected from any batch. The Contractor shall make its own determination and give its own instructions to its agents, employees and concrete supplier as to the total quantity of ingredients to be purchased as a

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cubic yard of concrete. The right is reserved to the Construction Administrator and Engineer, however, to verify yields after batch weights have been established by the Contractor and to order a reduction in total weight per load in the event his/her calculations show that the rated capacity of truck mixers, if approved for use, will be exceeded.

24. DAMAGE DUE TO CONTRACTOR'S OPERATIONS

In the event that damage is caused to structures, surfacing, pavement, shrubbery, trees or to grassed areas through trucking operations, delivery of materials, the actual performance of the work, or other causes, the Contractor shall fully restore the same to their original condition at its own expense. In the event that more than one contractor causes damages to any one area, the Director of Project Management will apportion the amount of repair work to be done by each contractor. The decision of the Director of Project Management shall be final and binding upon the Contractor(s) and may not be challenged except pursuant to a proceeding brought pursuant to Article 78 of the Civil Practice Law and Rules.

25. PROPERTY DAMAGE

The Contractor shall not enter upon nor make use of any private property along the line of work except when written permission is secured from the owner of that property. In case of any damage or injury done along the line of work in consequence of any act or omission on the part of the Contractor, or any one in its employ, in carrying out the contract, the Contractor shall at its own expense restore the same or make repairs as are necessary in consequence thereof in a manner satisfactory to the owner of the affected property; provided, however, that the obligation thus assumed by the Contractor shall not inure directly or indirectly to the benefit of any insurer of physical damage to property or loss of use, rents or profits of property regardless of whether the insurer has actually paid the claim or made only a loan to its insured, nor to the latter if it shall waive or abandon any claim against its insurer or insurers.

In case of failure on the part of the Contractor to restore or repair such property in a manner satisfactory to the owner of the affected property, the party of the first part may upon forty-eight hours notice to the Contractor proceed with such restoration or repair. The expense of such restoration or repair shall be deducted from any monies, which are due or may become due the Contractor under its contract. The Construction Administrator shall be the sole judge as to what constitutes failure to restore or repair as above stated and service of notice by mail addressed to the Contractor at the address stated in the proposal shall be sufficient.

26. CLAIMS FOR DAMAGES

The Contractor agrees that it will make no claim against the County or any of its representatives for damages for delay, interference or disruption of any kind in the performance of its Contract and further agrees that any such claim arising from acts or failure to act of the County or any of its representatives shall be fully and exclusively compensated for by an extension of time to complete the performance of the work as provided herein.

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27. EXTENSIONS OF TIME

An extension or extensions of time may be granted only by the Commissioner and only upon a verified application therefore by the Contractor. Each application for an extension of time must set forth in detail the nature of each cause of delay in the completion of the work, the date upon which each such cause of delay began and ended, and the number of days attributable to each of such causes. If the schedule for this project is based upon the Critical Path Method, the Contractor must also demonstrate that the delay for which an extension of time is sought occurred on the critical path. A formal written notice of the Contractor's intent to apply for an extension of time must be submitted to the Commissioner within seven (7) calendar days of the start of the alleged delay. The formal application for the extension of time must be submitted to the Commissioner no later than ten (10) calendar days after the end of the delay, but in no event later than the Contractor's submittal of its application for its substantial completion payment. The failure of the Contractor to timely submit either its formal written notice of its intent to apply for an extension of time or the application thereof shall be deemed a waiver of any entitlement to any extension of time.

The Contractor shall be entitled to an extension of time for delay in completion of the work caused solely (1) by the acts or omissions of the County, its officers, agents or employees; or (2) by the acts or omissions of other Contractors on this project; or (3) by supervening conditions entirely beyond the control of either party hereto (such as, but not limited to, Acts of God, excessive inclement weather, war, or any other national emergency making performance temporarily impossible or illegal, or strikes or labor disputes not brought about by any act or omission of the Contractor).

The Contractor shall not be entitled to receive a separate extension of time for each of several causes of delay operating concurrently, but, if at all, only for the actual period of delay in completion of the work as determined by the Engineer or Commissioner. If one of multiple causes of delay operating concurrently results from any act or omission of the Contractor or of its subcontractors of whatever tier, and would of itself (irrespective of concurrent causes) have delayed the work, no extension of time will be allowed for the period of delay resulting from such act or omission and the Contractor shall re-arrange his Progress Schedule and operations so as to complete the Work within the time set forth in the Contract and minimize the impact of the Work on the other Prime Contractors.

The determination made by the Commissioner or Engineer on an application for an extension of time shall be binding and conclusive on the Contractor and may not be challenged except in a proceeding commenced pursuant to Article 78 of the Civil Practice Law and Rules.

Permitting the Contractor to continue with the work after the time fixed for its completion has expired, or after the time to which such completion may have been extended has expired, or the making of any payment to the Contractor after such time, shall not operate as waiver on the part of the County of any of its rights or remedies under this contract nor shall it relieve the Contractor from his obligation under the Contract, including without limitations its liability to the County for liquidated damages, engineering costs, delays, damages, and/or costs incurred by the County.

If the Commissioner deems it advisable and expedient to have the Contractor complete and furnish the Work after the expiration of the time of Completion of Work (see "Required

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Time For Completion Of The Work” of the General Requirements) and in order that the County’s fiscal officers may be permitted to make payment to the Contractor for Work performed beyond that date, the Commissioner may extend the Contract solely for the purpose of enabling the Contractor to be paid for Work performed. This extension shall in no way relieve the Contractor from his obligation under the Contract, including without limitations its liability to the County for liquidated damages, engineering costs, delays, damages, attorney’s fees and/or costs incurred by the County, nor shall such extension of time be asserted by the Contractor in any action or proceeding as evidence that it completed its work in a timely manner.

The time necessary for review by the Engineer of all submittals including vendors, shop drawings, substitutions, etc., and delays incurred by normal seasonal and weather conditions should be anticipated and is neither compensatory nor eligible for Extensions of Time.

When the Work embraced in the Contract is not completed on or before the date specified herein, engineering and inspection expenses incurred by the County of Westchester upon the Work from the completion date originally fixed in the Contract to the final date of completion of the Work may be charged to the Contract and be deducted from the final monies due the Contractor.

28. REQUEST FOR APPROVAL OF EQUAL

A. GENERAL REQUIREMENTS

Wherever in the Contract Documents an article, material, apparatus, product or process is called for by trade name or catalog reference, or by the name of the patentee, manufacturer or dealer, it is understood that it constitutes the standard requirement to meet the contract specifications. Where two or more articles, materials, apparatus, products or processes are listed as acceptable by reference to trade name or otherwise, the choice of these will be optional to the bidder.

Bidders may base their bid on one of the specified items, or they may base their bid on an “equal”. However, the bidder should be aware that the County makes the final determination as to what constitutes an equal.

If the Engineer shall reject the proposed equal as not being the equal of that specifically named in the contract, the successful bidder (Contractor) shall immediately proceed to furnish the designated article, material, apparatus, product or process as specified or an approved equal without additional cost or time delay to the County.

B. REVIEW PROCESS

- 1) Within fifteen (15) days from the Notice to Proceed, requests for approval of equals must be proposed to the Commissioner on the “Request For Approval Of Equal” form of the Sample Forms. This Period for submitting requests will be strictly enforced. Such requests shall conform to the requirements of this Article.
- 2) Requests for approval of equals will be received and considered from Prime Contractors only and not from manufacturers, suppliers, Subcontractors, or other third parties.
- 3) If the materials and equipment submitted are offered as equals to the Contract

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Documents the Contractor shall advise the County and the Engineer of the requested equal and comply with the requirements hereinafter specified in this Article.

- 4) Where the acceptability of an equal is conditioned upon a record of satisfactory operation and the proposed equal does not fulfill this requirement, the Engineer, at his/her sole discretion, may accept the equal if the Contractor provides a bond or cash deposit which guarantees replacement at no cost to the County for any failure occurring within the specified time. The equal item must meet all other technical requirements contained in the Specification.
- 5) The successful bidder shall furnish such information as required by the Engineer to demonstrate that the equal article, material, apparatus, product or process is the equal of that specified in quality, finish, design, efficiency and durability and has been elsewhere demonstrated to be equally serviceable for the purpose for which it is intended. The Contractor shall set forth the reasons for desiring to utilize the proposed equal.
- 6) Contractor shall submit:
 - a. For each proposed request for approved equal sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the Engineer to determine if the proposed request for approved equal is equal, including manufacturer's brand or trade names, model numbers, description of specification of item, performance data, test reports, samples, history of service, and other data as applicable.
 - b. Certified tests, where applicable, by an independent laboratory attesting that the proposed equal is equal.
 - c. A list of installations where the proposed equal equipment or materials is performing under similar conditions as specified.
- 7) Requests for approval of equal after the period set forth in B. REVIEW PROCESS, Paragraph 1, above will not be accepted for evaluation except in case of strikes, discontinuance of manufacturer or other reason deemed valid by the Engineer whereby the specified products or those approved are unattainable. In such case the Contractor shall provide substantial proof that the acceptable products are unavailable.
- 8) Where the approval of an equal requires revision or redesign of any part of Work, including that of other Contracts, all such revision and redesign, and all new drawings and details required therefore, shall be provided by the Contractor at its own cost and expense, and shall be subject to the approval of the Commissioner.
- 9) In the event that the Engineer is required to provide additional engineering services, then the engineer's charges for such additional services shall be promptly paid by the Contractor to the County.
- 10) Any modifications in the Work required under other Contracts to accommodate the changed design will be incorporated in the appropriate Contracts and any resulting increases in Contract prices will be paid by the Contractor who initiated the

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changed design to the County.

- 11) In all cases the Engineer shall be the judge as to whether a proposed equal is to be approved. The Contractor shall abide by his/her decision when proposed equal items are judged to be unacceptable and shall in such instances furnish the item specified or indicated. No equal items shall be used in the Work without written approval of the Engineer.
- 12) In making request for approval of equal, Contractor represents that:
 - a. Contractor has investigated proposed equal, and determined that it is equal to or superior in all respects to the product, manufacturer or method specified.
 - b. Contractor will provide the same or better warranties or bonds for proposed equal as for product, manufacturer or method specified.
 - c. Contractor waives all claims for additional costs or extension of time related to proposed equal that subsequently may become apparent.
 - d. Contractor shall have and make no claim for an extension of time or for damages by reason of the time taken by the Engineer in considering an equal proposed by the Contractor or by reason of refusal of the Engineer to approve an equal proposed by the Contractor. Any delays arising out of consideration, approval, or utilization of an equal shall be the sole responsibility of the Contractor requesting the equal and it shall arrange its operations to make up the time lost.
- 13) Proposed Equal Will Not Be Accepted If:
 - a. Acceptance will require substantial revision of Contract Documents.
 - b. They will change design concepts or Technical Specifications.
 - c. They will delay completion of the Work, or the Work of other Contractors.
 - d. They are indicated or implied on a Shop Drawing and are not accompanied by a formal request for approval of equal from Contractor.
- 14) Only those products originally specified and/or added by approved requests for equals submitted in accordance with the preceding paragraphs may be used in the Work. Whenever requests for equals are approved, it shall be understood that such approval is conditional upon strict conformance with all requirements of the Contract and further subject to the following:
 - a. Any material or article submitted for approval in accordance with the above procedure must be equal, in the sole opinion of the Engineer, to the material or article specified. It must be readily available in sufficient quantity to prevent delay of any Work; it must be available in an equivalent color, texture, dimension, gauge, type and finish as to the item or article specified; it must be equal to the specified item in strength, durability, efficiency, serviceability, compatibility with existing systems, ease and cost of maintenance; it must be compatible with the design and not necessitate substantial design modifications; it must be equal in warranties and guarantees; its use must not impose substantial additional Work, or require substantial changes in the Work of any

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- other Contractor. Availability of spare parts shall be assured for the useful life of the Project.
- b. The Engineer reserves the right to disapprove, for aesthetic reasons, any material or equipment on the basis of design or color considerations alone, without prejudice to the quality of the material or equipment, if the manufacturer cannot meet the required colors or design.
 - c. All requests for approval of equals of materials or other changes from the contract requirements shall be accompanied by an itemized list of all other items affected. The Engineer shall have the right, if such is not done, to rescind any approvals for equals or changes and to order such Work removed and replaced with Work conforming to the specified requirements of the contract, all at the Contractor's expense, or to assess all additional costs resulting from the equal to the Contractor.
- 15) Approval of an equal will not relieve Contractor from the requirement to submit Shop Drawings or any of the provisions of the Contract Documents.
- 16) In the event that the Engineer is required to provide additional engineering services as a result of a request for approval of an equal of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or as a result of Contractor's errors, omissions or failure to conform to the requirements of the Contract Documents or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, or for evaluation of deviations from Contract Documents, then the Engineer's charges in connection with such additional services shall be paid by the Contractor to the County.
- 17) The Contractor shall respond to required submittals with complete information and with a degree of accuracy to achieve approvals within three (3) submissions. All costs to the Engineer involved with subsequent submissions requiring approval, will be paid by the Contractor to the County.

29. SUBSTITUTION

- A. Should the Contractor desire to substitute other articles, materials, apparatus, products or processes than those specified or approved as equal, the Contractor shall apply to the Engineer in writing for approval of such substitution. It should be noted that the bid shall not be based on a substituted article, material, apparatus, product or process. With the application shall be furnished such information as required by the Engineer to demonstrate that the article, material, apparatus, product or process he wishes to use is the equivalent of that specified in quality, finish, design, efficiency and durability and has been elsewhere demonstrated to be equally serviceable for the purpose for which it is intended. The Contractor shall set forth the reasons for desiring to make the substitution and shall further state what difference, if any, will be made in the construction schedule and the contract price for such substitution should it be accepted; it being the intent hereunder that any savings shall accrue to the benefit of the County.

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- B. If the Engineer shall reject any such desired substitution as not being the equivalent of that specifically named in the contract, or if it shall determine that the adjustment in price in favor of the County is insufficient, the Contractor shall immediately proceed to furnish the designated article, material, apparatus, product or process.
- C. Request for substitutes must be proposed to the Commissioner on the "Request For Approval Of Substitution" form of the Sample Forms. Such requests shall conform to the requirements of this Article.
- D. Requests for substitutions shall include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the County.
- E. Requests for utilization of substitutes will be reviewed during the course of the project. The impact on the project and the timeliness of submission will be of key consideration.
- F. The approval of utilization of a substitute is subject to the sole and final discretion of the Engineer.
- G. REVIEW PROCESS
 - 1) Requests for approval of substitutions will be received and considered from Prime Contractors only and not from manufacturers, suppliers, Subcontractors, or other third parties.
 - 2) If the materials and equipment submitted are offered as substitutions to the Contract Documents or approved equal the Contractor shall advise the County and the Engineer of the requested substitutions and comply with the requirements hereinafter specified in this Article.
 - 3) Where the acceptability of substitution is conditioned upon a record of satisfactory operation and the proposed substitution does not fulfill this requirement, the Engineer, at his/her sole discretion, may accept the substitution if the Contractor provides a bond or cash deposit which guarantees replacement at no cost to the County for any failure occurring within the specified time. The substitution item must meet all other technical requirements contained in the Specification.
 - 4) The Contractor shall furnish such information as required by the Engineer to demonstrate that the equal article, material, apparatus, product or process is the equivalent of that specified in quality, finish, design, efficiency and durability and has been elsewhere demonstrated to be equally serviceable for the purpose for which it is intended and/or that it offers substantial benefits to the County in saving of time and/or cost. The Contractor shall set forth the reasons for desiring to make this substitution.
 - 5) Contractor shall submit:
 - a. For each proposed request for approved substitute sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the Engineer to determine if the proposed request for approval should be granted, including manufacturer's brand or trade names, model numbers, description of specification of item, performance data, test reports, samples, history of service, and other data as applicable.

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- b. Certified tests, where applicable, by an independent laboratory attesting to the performance of the substitute.
 - c. A list of installations where the proposed substitute equipment or materials is performing under similar conditions as specified.
- 6) Where the approval of a substitute requires revision or redesign of any part of Work, including that of other Contracts, all such revision and redesign, and all new drawings and details required therefore, shall be provided by the Contractor at its own cost and expense, and shall be subject to the approval of the Engineer.
- 7) In the event that the Engineer is required to provide additional engineering services, then the engineer's charges for such additional services shall be paid by the Contractor to the County.
- 8) Any modifications in the Work required under other contracts to accommodate the changed design will be incorporated in the appropriate contracts and any resulting increases in contract prices will be charged to the Contractor by the County who initiated the changed design.
- 9) In all cases the Engineer shall be the judge as to whether a proposed substitute is to be approved. The Contractor shall be bound by his/her decision. No substitute items shall be used in the Work without written approval of the Engineer.
- 10) In making request for approval of substitute, Contractor represents that:
- a. Contractor has investigated proposed substitute, and determined that it is equal to or superior in all respects to the product, manufacturer or method specified or offers other specified advantages to the County.
 - b. Contractor will provide the same or better warranties or bonds for proposed substitute as for product, manufacturer or method specified.
 - c. Contractor waives all claims for additional costs or extension of time related to proposed substitute that subsequently may become apparent.
 - d. Contractor shall have and make no claim for an extension of time or for damages by reason of the time taken by the Engineer in considering a substitute proposed by the Contractor or by reason of failure of the Engineer to approve a substitute proposed by the Contractor. Any delays arising out of consideration, approval, or utilization of a substitute shall be the sole responsibility of the Contractor requesting the substitute and it shall arrange its operations to make up the time lost.
- 11) Proposed substitute will not be accepted if:
- a. Acceptance will require substantial revision of Contract Documents.
 - b. They will substantially change design concepts or Technical Specifications.
 - c. They will delay completion of the Work, or the Work of other Contractors.
 - d. They are indicated or implied on a Shop Drawing and are not accompanied by a formal request for approval of substitute from Contractor.
- 12) The Engineer reserves the right to disapprove, for aesthetic reasons, any material or

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equipment on the basis of design or color considerations alone, without prejudice to the quality of the material or equipment, if the manufacturer cannot meet the required colors or design.

- 13) All requests for approval of substitutes of materials or other changes from the contract requirements, shall be accompanied by an itemized list of all other items affected by such substitution or change. The Engineer shall have the right, if such is not done, to rescind any approvals for substitutions and to order such Work removed and replaced with Work conforming to the specified requirements of the contract, all at the Contractor's expense, or to assess all additional costs resulting from the substitution to the Contractor.
- 14) Approval of a substitute will not relieve Contractor from the requirement to submit Shop Drawings or any of the provisions of the Contract Documents.
- 15) In the event that the Engineer is required to provide additional engineering services as a result of a request for approval of a substitute results in changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or as a result of Contractor's errors, omissions or failure to conform to the requirements of the Contract Documents or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, or for evaluation of deviations from Contract Documents, then the Engineer's charges in connection with such additional services shall be paid by the Contractor.
- 16) Structural design shown on the Drawing is based upon the configuration of and maximum loading for major items of equipment as indicated on the Drawings and as specified. If the substituted equipment furnished differs from said features, the Contractor shall pay to the County all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's charges in connection therewith.
- 17) The Contractor shall respond to required submittals with complete information and with a degree of accuracy to achieve approvals within two (2) submissions. All costs to the Engineer involved with subsequent submissions of Shop Drawings, Samples or other items requiring approval, will be paid by the Contractor to the County, by deducting such costs from payments due for Work completed. In the event an approved item is requested by the Contractor to be changed or substituted for, all costs involved in the reviewing and approval process will likewise be backcharged to the Contractor unless determined by the Engineer that the need for such substitution and/or deviation from Contract Documents is beyond the control of the Contractor.

30. EXTRA WORK: INCREASED COMPENSATION/DECREASED WORK: CREDIT TO THE OWNER

The Director of Project Management may, at any time, by a written order, and without notice to the sureties, require the performance of Extra Work or require or approve changes in the work, or Decreased Work ("work" to include but not be limited to specified methods of performing work) as he may deem necessary or desirable. The amount of compensation

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to be paid to the Contractor for any Extra Work, as so ordered, or credit to the Owner for such decreased work, as so ordered or approved, shall be determined as follows:

- 1) **First:** By such applicable unit prices, if any, as set forth in the Contract; or
- 2) **Second:** If no such prices are so set forth, then by unit prices or by a lump sum, or sums, mutually agreed upon by the Director of Project Management and the Contractor; or
- 3) **Third:** If, in the opinion of the Director of Project Management, the aforesaid unit prices, under "First" above, are not applicable, or if the two parties hereto cannot reach agreement as to new unit prices or a lump sum, or sums, under "Second" above, then by the actual net cost in money to the Contractor of the materials and of the wages of applied labor (including cost of supplements provided and premiums for Workmen's Compensation Insurance, FICA, and Federal and State Unemployment Insurance) required for such Extra Work, plus twenty (20%) percent as compensation for all items of profit and costs or expenses including administration, overhead, superintendence, insurance (other than those specifically noted above) materials used in temporary structures, allowances made by the Contractor to subcontractors, including those made for overhead and profit, additional premiums upon the performance bond of the Contractor and the use of small tools and any and all other costs and expenses not enumerated above, plus such rental for plant and equipment (other than small tools) required and approved for such extra work. Where extra work is performed by a Subcontractor, the twenty percent stipulated above shall be divided between the Contractor and the Subcontractor as per their contractual agreement, or if not defined therein, then as the Contractor sees fit.

Rental rates for any power operated machinery, trucks or equipment, which it may be found necessary to use as in "Third" above, shall be reasonable and shall be based on those prevailing in the area of the County where such work is to be done, and they shall be agreed upon in writing before the work is begun.

In no case shall the rental rates submitted exceed the rates set up in the current edition of "Equipment Watch" plus the cost of fuel and lubricants.

These rates shall include all repairs, fuel, lubricants, applicable taxes, insurance, depreciation, storage and all attachments complete, ready to operate, but excluding operators. Operators shall be paid as stated here in above for labor.

For equipment, which is already on the project, the rental period shall start when ordered to work by the Construction Administrator, and shall continue until ordered to discontinue by him. The minimum payment for any one rental period shall be four hours, unless otherwise agreed upon between the Construction Administrator and the Contractor.

For equipment which has to be brought to the project, specifically for use as in "Third" above, the County will pay all loading and unloading costs, also all transportation costs will not be paid, if the equipment is used for work other than in "Third" above while on the project. The rental period shall begin at the time the equipment has been unloaded on the

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project, and shall end on and include the day the order to discontinue the use of the equipment as in "Third" above is given to the Contractor by the Construction Administrator.

The daily rate shall apply for rental periods of four calendar days or less, the weekly rate shall apply for rental periods of more than four and not exceeding twenty-one calendar days, and the monthly rate shall apply for rental periods in excess of twenty-one calendar days. For fractional periods above the full unit rental period (day, week, month) reimbursement shall be proportioned on the basis of the applicable rental period. (Day-8 hrs.; Week-7 calendar days; Month-30 calendar days).

No percentage shall be added to the amounts of equipment rental prices agreed upon, but the price agreed upon shall be the total compensation allowed for the use of such equipment.

The provisions hereof shall not affect the power of the Contractor to act in case of emergency.

31. DISPUTED WORK - NOTICE OF CLAIMS FOR DAMAGES

If the Contractor is of the opinion that any work required, necessitated, or ordered violates or conflicts with or is not required by the terms and provisions of this Contract, it must promptly, within five (5) calendar days after being directed to perform such work, notify the Construction Administrator, in writing, of its contentions with respect thereto and request a final determination thereon. If the Construction Administrator determines that the work in question is contract and not extra work, or that the order complained of is proper, he will direct the Contractor in writing to proceed and the Contractor shall promptly comply. In order, however, to preserve its right to claim compensation for such work or damages resulting from such compliance, the Contractor must, within seven (7) calendar days after receiving notice of the Construction Administrator's determination and direction, notify the Construction Administrator, in writing that the work is being performed or that the determination and direction is being complied with, under protest. Failure of the Contractor to so notify shall be deemed as a waiver of claim for extra compensation or damages therefore.

While the Contractor is performing disputed work or complying with a determination or order under protest in accordance with this Article, in each such case the Contractor shall furnish the Construction Administrator daily with three copies of written statements signed by the Contractor's representatives at the site showing:

- 1) the name of each worker employed on such work or engaged in complying with such determination or order, the number of hours employed thereon, and the character of the work each is doing; and
- 2) the nature and quantity of any materials, plant and equipment furnished or used in connection with the performance of such work or compliance with such order, and from whom purchased or rented.

It is expressly agreed that no dispute over the scope of the Contractor's work or any portion thereof shall cause any delay or interruption to the Contractor's work.

In addition to the foregoing statements, the Contractor shall, upon notice from the Board of Acquisition and Contract, produce for examination by the duly appointed representative of

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the Board of Acquisition and Contract, all its books of accounts, bills, invoices, payrolls, subcontracts, time books, daily reports, bank deposit books, bank statements, check books and canceled checks, showing all of its acts and transactions in connection with or relating to or arising by reason of this contract, and submit itself, its agents, servants and employees for examination under oath by any duly appointed representative designated by the Board of Acquisition and Contract to investigate claims made against the County. Unless the aforesaid statements shall be made and filed within the time aforesaid and the aforesaid records submitted for examination and the Contractor, its agents, servants, and employees submit themselves for examination as aforesaid, the County shall be released from all claims arising under, relating to or by reason of this contract, except for the sums certified by the Construction Administrator to be due and agreed that no person has power to waive any of the foregoing provisions, and that in any action against the County to recover any sum in excess of the sums certified by the Construction Administrator to be due under or by reason of this contract, the Contractor must allege in its complaint and prove, at the trial, strict compliance with the provisions of this article.

Before final acceptance of the work by the County, all matters of dispute must be adjusted to the mutual satisfaction of the parties thereto. Determinations and decisions in case any question shall arise, shall constitute a condition precedent to the right of the Contractor to receive the money therefore, until the matter in question has been adjusted.

32. CONTRACTOR'S SUBCONTRACTS AND MATERIAL LISTS

Within fifteen (15) days after execution of the Contract, the successful bidder shall submit to the County for approval a list of the subcontractors, materialmen and materials that he/she plans to use in the performance of the work and statements of the work they are to perform. The format and content of the list shall be in accordance with directives from the Construction Administrator. He/sit shall also submit additional information regarding their qualifications as may be later requested by the County. No part of the work may be sublet until after the Contractor has received the County's approval.

The Contractor shall be fully responsible for all acts and omissions of its subcontractors and persons directly or indirectly employed by them, and the County's approval to sublet parts of the work will in no way relieve the Contractor of any of its obligations under the Contract. All dealings of the Construction Administrator with the subcontractors shall be through the Contractor, subcontractors being recognized by the County only as employees of the Contractor.

By executing the Agreement, the Contractor represents that the Contractor shall insert appropriate clauses in all subcontracts to bind the subcontractors to the Contractor by all applicable provisions of the Contract Documents executed between the Contractor and the County, but this shall not be construed as creating any contractual relationships between subcontractors and the County. Prior to approval of the subcontractors, the County has the right to review and recommend changes in the subcontracts. The County reserves the right to reject any subcontractor proposed by the Contractor if in the reasonable opinion of the County such subcontractor lacks the experience, capability or integrity to perform its subcontract work or is otherwise non-responsible.

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By executing the Agreement, the Contractor represents that the Contractor shall insert appropriate clauses in each subcontract that require that if the Contractor is terminated by the County either for default or convenience that at the sole option of the County the subcontract shall automatically attach to the County and the subcontractor shall continue without delay or interruption to fully perform all of the obligations required by its subcontract.

Where the specifications permit the Contractor a choice of different materials or manufactured products, it shall state the choice he has made in making up its bid, with the understanding that all choices must subsequently be approved by the Commissioner, after award of the contract to the successful bidder. If the bidder wishes to propose utilization of materials or manufactured products other than those specified, it shall so state and submit the required information in accordance with Article "Request For Approval Of Equal" of the General Clauses."

33. ASSIGNMENT OF CONTRACT

The Contractor shall not assign, transfer, convey or otherwise dispose of the contract or any part of it or any monies due and payable under the contract, without prior written approval of the County. If such approvals are granted by the County, they shall in no way relieve the Contractor or from any obligations under the terms of this Contract.

All documents assigning the contract or any part of it or any monies due and payable under the contract shall contain a clause stating that all monies to be paid the assignee in accordance with the terms of the Contractor's contract with the County, are subject to a prior lien for services rendered or materials and equipment supplied, in favor of all persons, firms or corporations rendering such services or supplying such materials and equipment.

34. PAYMENT FOR GENERAL PROVISIONS

No direct payment will be made for work done or materials furnished in compliance with the General Provisions of the specifications, unless otherwise noted. All compensation to the Contractor for its performance of the requirements of any general provision shall be considered to have been included in the prices he has bid for the individual items if a unit price contract and/or for a lump sum price if a lump sum contract.

In the event the Contractor fails or refuses to proceed with its work and/or correct or repair deficient or defective work then without prejudice to any and all of the County's other rights and remedies, and upon three (3) days notice to Contractor, the County may perform and/or employ any other person or persons to correct and/or repair any or all such work. All costs incurred by the County pertaining thereto shall be paid forthwith by the Contractor to the County.

35. COSTS INCURRED BY COUNTY

Wherever in these Contract Documents the County is entitled to recover costs from the Contractor or charge the Contractor for the costs incurred for the correction, supervision or for any other reason related to the Contractor's work or arising from the Contractor's failure or refusal to proceed with its work in a timely manner, such costs and/or charges shall be

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deemed to include, but not be limited to, the County's costs and fees for inspection(s), engineering, consultant(s) and attorneys.

36. GUARANTEE OF WORK

- A. Except as otherwise specified, all work performed under the Contract shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, equipment or workmanship for one year from the guarantee starting date (which shall be defined as the date of the County's approval of the final Certificate for Payment or the date of actual full occupancy of the building, whichever is earlier). The building, section thereof, or item of equipment, shall be occupied or put into actual use by the Owner only after judged completed by the Construction Administrator and Owner and approved by him as ready for occupancy.
- B. If, within any guarantee period, repairs or changes are required in connection with guaranteed work, which in the opinion of the Construction Administrator or Owner is rendered necessary as a result of the materials, equipment or workmanship which are inferior, defective, or not in accordance with terms of the Contract, the Contractor shall promptly upon receipt of notice from the Construction Administrator or Owner and without expense to the Construction Administrator or Owner:
 - 1) Place in satisfactory condition, in every particular, all of such guaranteed work, correct all defects thereof, and
 - 2) Make good all damages to the building or site, or equipment or contents thereof, and
 - 3) Make good any work or material, or equipment and contents of said building or site disturbed in fulfilling any such guarantee.
- C. In any case where in fulfilling requirements of the Contract or of any guarantee embraced in or required thereby the Contractor disturbs any work, it shall restore such disturbed work to a condition satisfactory to the Construction Administrator.
- D. If the Contractor, after notice, fails to proceed promptly to comply with terms of its guarantee, the Owner may have the defects corrected and the Contractor shall be liable for all expenses incurred.
- E. All special guarantees applicable to definite parts of the work that may be stipulated in the Specifications or other papers forming a part of the Contract shall be subject to the requirements and term of this article.

37. SEPARATE CONTRACTS

- A. Contractor's attention is specifically directed to the fact that, because of the work of other contracts within and adjacent to the limits of this Contract they may not have exclusive occupancy of the territory within or adjacent to the limits of this Contract.
- B. Contractor's attention is further directed to the fact that, during the life of this Contract the owners and operators of Public Utilities may make changes in their facilities. These changes may be made by the Utility employees or by contract within the limit or adjacent to these contracts and may be both temporary and permanent.

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- C. Contractor shall be required to cooperate with other contractors and the owners of the various utilities, and to coordinate and arrange the sequence of their work to conform to the progressive operations of the work already under contract and to be put under contract.
- D. Contractor shall be responsible for the coordination of the work of their various subcontractors. Their respective operations shall be arranged and conducted so that delays will be avoided. Where the work of a subcontractor overlaps or dovetails with that of other subcontractors, materials shall be delivered and operations conducted so as to carry on the work continuously in an efficient and workmanlike manner. Delays or oversights on the part of Contractor or its subcontractors or utility owners in getting any or all of their work done in the proper way thereby causing cutting, removing and replacing work already in place, shall not be the basis for claim for extra compensation.
- E. In case of interference between the operations of the utility owners and different Contractors, the Construction Administrator will be the sole judge of the rights of each Contractor and the sequence of work necessary to expedite the completion of the entire project, and in all cases the Construction Administrator's decision shall be accepted as final and may not be challenged except in a proceeding brought pursuant to Article 78 of the Civil Practice Law and Rules.

38. COOPERATION WITH OWNER

Each Contractor shall cooperate with the Owner as to parking of vehicles, availability of storage and working areas and confining of activities and personnel to same. **NO PARKING FOR CONTRACTOR'S EMPLOYEES.**

39. JOB MEETINGS & PROJECT SUPERINTENDANT

- A. An officer of the Contractor, or its project manager or superintendent, who is fluent in English and authorized to make binding decision on behalf of the Contractor shall attend job meetings with the Commissioner and/or the Construction Administrator, and any subcontractors whom the Inspector may designate; for the purpose of discussing expedition, execution and coordination of the work.
- B. Job meetings will be scheduled periodically (the first to be prior to commencement of construction) at a time and place designated by the Construction Administrator.
- C. The Contractor shall not commence any work prior to the first (pre-construction) meeting between the Contractor, Commissioner and/or Construction Administrator, client, and other concerned governmental and utility company representatives.
- D. At the pre-construction meeting, the scheduling of the work on an arrow-flow diagram (showing chronologically and in detail the sequence and methods that will be followed) will be provided, and details for the proper execution and special requirements of the work will be explained and discussed.
- E. The Contractor shall be responsible for providing a detailed construction schedule that provides for a Critical Path Method ("CPM") and which is compatible with any of the state of the art CPM Method scheduling software.

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F. Updated coordinated arrow-flow diagrams or CPM schedules, as the case may be, will be provided by the Contractor, as above, on a monthly basis to the County.

The Contractor shall indicate on the construction schedules noted above, time for shop drawing preparation, approvals, fabrication and delivery of materials and equipment for major items. The County may request that additional important items be included on the schedule.

G. The Contractors shall ensure that its Project Superintendent shall be on site full time at all times when the Contractor's Work is being performed.

40. PATENT WARRANTY

A. Contractor expressly represents, warrants and agrees that he has the legal right to furnish and install and to authorize the County to purchase and use the equipment hereby offered and each and every one of its several parts and every feature thereof, under one or the other, or partly under one and partly under the other of the following representations.

- 1) That the Contractor possesses a valid patent(s) covering the equipment to be furnished hereunder or part or features thereof or has or will obtain permit(s) and license(s) authorizing the Contractor to furnish and install same and to authorize the purchase and use thereof by the County.
- 2) The Contractor is responsible before ordering material, equipment, parts, systems, etc, to verify that the suppliers of all such material, equipment, parts, systems, etc, will supply the required warranty, guarantee, O & P manual, and maintenance service schedule.
- 3) That the equipment offered or certain parts or features thereof are not covered by any valid patent(s) within the knowledge of the Contractor.

B. Contractor further warrants and agrees that if any patent(s) is hereafter issued to any person whatsoever with respect to the equipment or any part or features thereof, to be furnished and installed hereunder, the Contractor will obtain such permit(s) or license(s) from the Patentee as may be necessary to authorize the use of the equipment by the County.

C. Contractor further represents, warrants and agrees that he and its sureties shall hold themselves responsible for and defend any claims made against the County for any infringement of patents due to the purchase and use by the County of said equipment or any part or feature thereof; that they will indemnify and save harmless the County from all costs, expenses and damages which it shall be obliged to pay by reason of any such infringement of patent(s); that in case the use of any such equipment is enjoined, they will bear the expenses of removing same and replacing same with equipment which will satisfactorily perform the function without constituting an infringement of any patent(s); and in case the use of any equipment shall be enjoined, that they shall pay to the County the sum of \$1,000.00 per day, as liquidated damages, for each and every day during which the County shall be enjoined from using the same up to the day on which such

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equipment is replaced by other equipment which will satisfactorily perform the same function but which will not constitute an infringement of any other patent(s).

- D. The Contractor further agrees in the event the use of any of the equipment is enjoined and the Contractor is unable within a reasonable time to devise other equipment which will satisfactorily perform the same functions without infringement on any patent(s), that he will remove the equipment and refund to the County the entire cost of its purchase and installation, plus the sum of \$ 1,000.00 per day as liquidated damages for each and every day until the substitute equipment has been purchased and installed by the County, excepting however that such period shall not exceed three months.
- E. The Contractor further agrees in the event that any claim or notice of claim for infringement of patent(s) are made or filed prior to the making of payment by the County for the equipment and/or material proposed to be furnished and installed hereunder, that the County may withhold any sum due to the Contractor for such equipment and/or material until such claims shall have been settled or adjudicated or until additional surety bonds or other guarantees of indemnification shall have been posted, if deemed necessary by the County for its protection.

41. MATERIALS

A. Quality

- 1) It is the intent of these Specifications to describe definitely and fully the character of materials and workmanship required with regard to all ordinary conditions of the work and to require first-class work and new and best quality materials in all particulars. For unexpected conditions arising during the progress of the work and not fully covered herein, the Specifications shall be interpreted by the Construction Administrator to require first-class work and materials and such interpretations shall be accepted by the Contractor.
- 2) The Contractor is responsible before ordering material, equipment, parts, systems, etc, to verify that the suppliers of all such material, equipment, parts, systems, etc, will supply the required warranty, guarantee, O & P manual, and maintenance service schedule.
- 3) Where materials or devices are specified in these documents by reference to government, manufacturer's association, or professional society standards, the pertinent sections of the latest edition of such standards shall have the same force and effect as if set forth in full in these Specifications. The following abbreviations shall be used as indicated for the principal societies:

AASHO	American Association of State Highway Officials
ACI	American Concrete Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute

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ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWI	American Woodworking Institute
AWS	American Welding Society
BHMA	Builders Hardware Manufacturers Association
CS	Commercial Standards
FS	Federal Specifications
IEEE	Institute of Electrical and Electronic Engineers
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
SDI	Steel Deck Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Incorporated
TCA	Tile Council of America, Incorporated
TMCA	Tile and Marble Contractors of America
UL	Underwriter's Laboratories, Incorporated

B. Delivery, Storage and Handling:

- 1) Materials shall be delivered in manufacturer's original sealed containers with complete identification of contents and manufacturer, and kept sealed in original containers until used. Labels shall not be removed until materials have been installed and inspected.
- 2) Materials shall be delivered, stored, and handled with proper equipment and in a manner to protect them from damage.
- 3) The Contractor shall make arrangements for the receipt of materials delivered to the construction site. No representative of the County will accept any materials ordered by the Contractor.
- 4) Finish materials shall be protected from dirt and damage, and perishable materials shall be stored within appropriate weatherproof enclosures.
- 5) Delivery of materials shall be coordinated with the Operations Schedule.
- 6) The Contractor shall confine the apparatus, the storage of materials and the operations of the workmen to the limits indicated by law, ordinances, permits, or directions of the Construction Administrator, and shall not encumber the premises beyond the contract limits.

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- 7) The Contractor shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.
- 8) Whenever the Contract Documents require delivery by the Contractor of any materials, equipment, or other items, the term delivery shall be deemed to include unloading and storing with proper protection where directed.

C. Federal Regulations

- 1) Should the Federal Government, because of Declaration of an Emergency, or other cause, establish controls over the use of certain construction materials, then the Contractor, immediately after signing the Contract or immediately after Declaration of an Emergency, shall furnish the Commissioner with an itemized list of all critical materials required for use on the project. For each item, the quantity required and the approximate date on which delivery will be required shall be indicated.

D. Name Plates

- 1) Each piece of operable equipment to be furnished and installed by a Contractor under its Contract such as motors, pumps, heaters, fans, transformers, switch and fuse racks and other similar equipment shall be provided with a substantial name plate of non-corrodible metal securely fastened in place and clearly and permanently inscribed with the manufacturer's name, the model or type designation, the serial number, the principal rated capacities, the electrical or other power characteristics and other similar and appropriate information.
- 2) Manufacturer's identification shall be inconspicuous, but where nameplates contain information relative to characteristics or maintenance, they shall be clearly visible and located for easy access.
- 3) The nameplate of a subcontractor or a distributor will not be permitted.

E. Manufacturer's Certification

- 1) Prior to the delivery of any water or sewer pipe to the construction site, the Contractor shall furnish properly attested documents certifying as to the type, class, name of manufacturer and source of supply of the pipe. One copy of each document shall be forwarded to the Construction Administrator at the construction site and to the Director of Project Management care of the Engineering Division, Michaelian Office Building, White Plains, New York.

F. Samples

- 1) The Contractor shall furnish, for approval of the Engineer, any samples required by the specifications or that may be requested by the Owner, of all materials he proposes to use, and shall pay all shipping charges for the samples. The Contractor shall send all samples to the office of the Engineer, except when directed otherwise. The sample of approved material will remain on file in the Engineer's office. A disapproved sample will be returned to the Contractor.
- 2) No samples are to be submitted with bids.
- 3) No materials or equipment of which samples are required to be submitted for

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approval shall be used on the work until such approval has been given by the Engineer or Construction Administrator, save only at the Contractor's risk and expense.

- 4) Each sample shall have a label indicating the material represented, its place of origin and the names of the producer, the Contractor and the Contract for which the material is intended.
- 5) Approval of any sample shall be only for characteristics or for uses named in such approval, and no other. No approval of a sample shall be taken in itself to change or modify any Contract requirement. When a material has been approved, no additional sample of that material will be considered and no change in brand or make will be permitted. Approved samples held by the Engineer will be returned to the Contractor upon completion of the work, if requested.
- 6) Transactions with manufacturers or subcontractors shall be through the Contractor.

G. Dissimilar Materials

- 1) Where metals are placed in contact with or fastened to dissimilar metals, concrete, masonry, wood or other absorptive materials subject to repeated wetting or wood treated with a preservative non-compatible with the metal or if drainage from dissimilar materials passes over the work; treat the contact surfaces with a heavy coat of approved alkali-resident bituminous paint.
- 2) Where one of the metals is aluminum, a coat of zinc-chromate primer shall be applied prior to the bituminous paint.

42. STANDARD OF QUALITY

Wherever in the contract documents an article, material, apparatus, device, product or process is called for by trade name or catalog reference, or by the name of the patentee, manufacturer or dealer, it shall be construed as establishing a standard of quality and not construed as limiting competition. In such instances, the Contractor may use any article, material, etc. which, in the judgment of the Engineer, expressed in writing, is equal to and acceptable for the intent specified.

43. PROPRIETARY ITEM

Whenever less than three names are used in proprietary item specifications, it has been determined that:

- A. The use of trade names is necessary for effective and workable specifications for the item.
- B. All manufacturers known by the individuals familiar with the trade involved have been listed.
- C. Equal items may be approved in accordance with Article "Request For Approval Of Equal" of the General Clauses.

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44. SHOP DRAWINGS

A. Shop Drawing Schedule

- 1) Within fifteen (15) days after the Notice to Proceed, the Contractor shall prepare and submit two (2) copies of its schedule of Shop Drawing submissions to the Engineer for review and approval. The schedule is to be submitted on the “Shop Drawing Schedule” form of the Sample Forms.
- 2) In order to maintain the construction schedule for this project the Contractor shall submit all Shop Drawings per approved schedule. The Contractor is expressly cautioned that its failure or refusal to timely submit a shop drawing schedule acceptable to the Engineer and/or any deviation from the approved shop drawing schedule shall be deemed a default under this Contract.
- 3) Shop Drawings shall be submitted without fail in time to permit correction, resubmission and final approval, as hereinafter specified, without causing any delay in the construction of any Work.
- 4) Samples and Shop Drawings, which are related to the same unit of Work or Specification Section, shall be submitted at the same time. If related Shop Drawings and Samples are submitted at different times, they cannot be reviewed until both are furnished to the Engineer.
- 5) The schedule shall be updated every four-(4) weeks or more frequently as required by the Engineer.
- 6) Two (2)-updated copies of the schedule shall be submitted to the Engineer with each application for Partial Payment.
- 7) Form of Schedule

Schedule shall be in tabular form with appropriate spaces to insert the following information for principal items of equipment and materials:

- a. Date on which Shop Drawings are requested and received from the manufacturer.
- b. Dates on which Shop Drawings are transmitted to the Engineer by the Contractor.
- c. Dates on which Shop Drawings are returned by the Engineer for revisions.
- d. Dates on which Shop Drawings are revised by manufacturer and resubmitted to the Engineer.
- e. Date on which Shop Drawings are returned by Engineer annotated either “Approved” or “Approved as Noted”.
- f. Date on which accepted Shop Drawings are transmitted to manufacturer and Contractor’s Invoice Number.
- g. Date of manufacturer’s scheduled delivery.
- h. Date on which delivery is actually made.

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i. Sample of schedule follows on next page.

B. Shop Drawing Requirements

- 1) Shop Drawings for the Work shall include working and setting drawings, schedules, shop details, wiring diagrams, manufacturer's catalog cuts and brochures and all other drawings, schedules and diagrams necessary for the proper correlation of the Work.

Insofar as it is practicable, all drawings shall be uniform in size. They shall be dated, numbered consecutively and shall be identified with the Contract Number and Title, a description of the material or equipment and the area of the work and where it is to be installed. Shop drawings shall accurately and clearly show sizes, work, erection dimensions, arrangement and sectional views, necessary details including information for making connection with the work of other items as may be required, materials and finishes, detailed parts lists, and performance characteristics and capacities as may be required.

- 2) All detailing for structural components shall be done in accordance with the provisions for design and workmanship in the latest additions of the publications listed below except as may be modified in the Contract Documents:

- a. "Manual of Steel Construction" of the American Institute of Steel Construction.
- b. "Building Code Requirements for Reinforced Concrete" and "Manual of Standard Practice for Detailing Reinforced Concrete Structures" of American Concrete Institute.

- 3) Detailing practices for other components shall be done to conform to the best trade practices.

4) Contractor Responsibilities

- a. Before submitting Shop Drawings to the Engineer all submittals from its Subcontractors, manufacturers or suppliers shall be sent directly to the Contractor for preliminary review, coordination and checking.

Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of material or equipment. Contractor shall thoroughly check all drawings for accuracy and conformance to the intent of the Contract Documents. Drawings found to be inaccurate or otherwise in error shall be returned to the Subcontractors, manufacturers, or suppliers by the Contractor for correction.

- b. All submittals, including Shop Drawings prepared by or under the direction of the various Contractors, shall be thoroughly checked by the Contractor for accuracy and checked by the Contractor for accuracy and conformance to the intent of the Contract Documents before being submitted to the Engineer and shall bear the Contractor's signature certifying that they have been so checked. Before submitting them to the Engineer, all submittals shall be properly labeled and consecutively numbered. In a clear space above the title block, the Contractor shall provide the "Shop Drawing ID" form of the Sample Forms, and enter the required information:

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- c. Shop Drawings shall be submitted as a single package including all associated drawings for any operating system and shall include all items of equipment and any mechanical units involved or necessary for the functioning of such system. Where applicable, the submittal shall include elementary wiring diagrams showing circuit functioning and necessary interconnecting wiring diagrams for construction.
- d. If the submittals contain any departures from the Contract Documents, specific mention thereof shall be made in the Contractor's letter of transmittal. Otherwise, the review of such submittals shall not constitute approval of the departure. The Contractor shall also call the Engineer's attention to any changes by the use of larger letters of at least 1" in height on the Shop Drawings along with a letter by the Contractor advising the Engineer to the recommended change and the reason therefore. If this is not done, even if the Work is incorporated in the construction, it will not be accepted by the Engineer even if Shop Drawings are "Approved".
- e. No materials or equipment shall be ordered, fabricated or shipped or any Work performed until the Engineer returns to the Contractor the submittals herein required, annotated "Approved".
- f. Where errors, deviations, and/or omissions are discovered at a later date in any of the submittals, the Engineer's prior review of the submittals does not relieve the Contractor of the responsibility for correcting all errors, deviations and/or omissions.
- g. Two (2) copies of Preliminary Operations and Maintenance Manuals shall be submitted with the final Shop Drawings for each item of equipment.
- h. Submittals shall be transmitted in strict compliance with Special Clause 10. A.2 and in sufficient time to allow the Engineer adequate time for review and processing so as not to delay the Project per the approved Shop Drawing Schedule.
- i. Contractor shall transmit five (5) prints of each submittal to the Engineer for review. Any submissions, which in the opinion of the Engineer, are not legible will not be reviewed and will be returned to the Contractor annotated "Disapproved".
- j. Contract drawings are for engineering and general arrangement purposes only and are not to be used as Shop Drawings.
- k. Shop Drawings shall accurately and clearly present the following:
 - All working and installation dimensions.
 - Arrangement and sectional views.
 - Units of equipment in the proposed positions for installation, details of required attachments and connections, and dimensioned locations between units and in relation to the structures.
 - Necessary details and information for making connections between the

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various trades including, but not limited to, power supplies and interconnecting wiring between units, accessories, appurtenances, etc.

- l. Structural and all other layout drawings prepared specifically for the Project shall have a plan scale of not less than 1/4-inch equal to 1 foot and they shall be not larger than the size of the Contract Drawings.
 - m. Where manufacturer's publications in the form of catalogs, brochures, illustrations, compliance certificates, or other data sheets are submitted in lieu of prepared Shop Drawings, such submissions shall specifically indicate the item for which approval is requested. Identification of items shall be made in ink, and submissions showing only general information are not acceptable.
 - n. The Contractor shall provide all required copies for the use of the various trades and at the Site, and one (1) copy of approved Shop Drawings shall be provided by the Contractor to each of the other Prime Contractors unless otherwise noted in writing by the Engineer.
 - o. The Contractor shall respond to required submittals with complete information and accuracy to achieve required approvals within three (3) submissions. All costs to the Owner involved with subsequent submissions of Shop Drawings, Samples or other items requiring approval, will be backcharged to the Contractor, at the rate of 3.0 times direct technical labor cost, by deducting such costs from payments due for Work completed. In the event an approved item is requested by the Contractor to be changed or substituted, all involved costs in the review process will likewise be paid by the Contractor to the County unless determined by the Director of Project Management or Commissioner that the need for such deviation is beyond the control of the Contractor. Contractor shall be responsible for coordinating its Work and submittals with its Subcontractors.. Should Contractor cause the need for additional submissions or reviews of previous submissions all involved costs will similarly be paid to the County.
- 5) Procedure for Review
- a. Shop Drawings will be checked for design conformance with the Contract Documents and general arrangement only.
 - b. Submittals will be annotated by the Engineer in one of the following ways:
 - "Approved" - no exceptions are taken.
 - "Approved as Noted" - minor corrections are noted and shall be made and a resubmittal is required.
 - "Disapproved because" - with specific deficiencies noted.
 - "Disapproved" - based on the information submitted, the submission is not in conformance with the Contract Documents. The deviations from the Contract Documents are too numerous to list and a completely revised submission of the proposed equipment or a submission of other equipment is required.

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- c. One copy of the reviewed submittals will be returned to the Contractor. It is the Contractor's responsibility to provide copies to:
- Its Subcontractors.
 - Its Materialmen and Suppliers.
- unless notified otherwise in writing by the Engineer.
- 6) Disapproved drawings will be returned to the Contractor for correction and resubmission. After the Contractor has had the required corrections made on the original drawing, it shall again submit five copies for review by the Engineer.
- 7) The acceptance of Shop Drawings by the Engineer shall be only general in nature and shall not relieve the Contractor of any responsibility for the accuracy of the drawings, the proper fitting and construction of the Work or for the furnishing of materials or other Work required by the Contract Documents, but not shown on the Shop Drawings. Acceptance of Shop Drawings by the Engineer shall not be construed as approving departures from the Contract requirements unless specifically noted by the Engineer. Acceptance of Shop Drawings for one item shall not be construed as approval for other changes even if noted by the Contractor on the drawing.
- 8) Shop Drawings submitted other than in accordance with the outlined procedures will be returned to the Contractor for resubmission and the Contractor shall bear all expense and risk of all delays as if no Shop Drawings had been submitted.
- 9) No Work shall be performed until the Shop Drawings have been accepted by the Owner, and the Contractor shall be responsible for all costs and damages, which may result from proceeding prior to the approval of the Shop Drawings.

45. SEQUENCE OF CONSTRUCTION OPERATIONS

- A. It is mandatory that the premises continue to be occupied and facilities therein shall continue to function during the performance of the construction work.
- B. Detailed sequence of construction and availability of spaces in areas through which services must pass shall be coordinated between the Owner and the Contractor, before actual commencement of the Work.
- 1) To enable the Work to be laid out and prosecuted in an orderly and expeditious manner, Contractor shall provide a proposed Progress Schedule, within fifteen (15) days after the issuance of the Notice to Proceed of this Contract unless otherwise directed in writing by the Construction Administrator. The proposed Progress Schedule shall show the anticipated time of commencement and completion of each of the various operations to be performed under this Contract; together with all necessary and appropriate information regarding the sequence and correlation of Work; and the Schedule of Shop Drawings and delivery of all materials and equipment required for the Work. The Contractor shall prepare a Master Progress Schedule (Schedule) for the Work. Contractor as directed by the Construction Administrator shall revise the proposed Schedule until each activity is properly sequenced to provide that the Work will be completed in the proper order and

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within the allotted Contract duration, without any conflicts. When the Construction Administrator has accepted the Schedule the Contractor will sign it. The Contractor shall then provide one (1) copy of such approved Schedule to each Subcontractor and two (2) copies to the Construction Administrator. Contractor shall afford its Subcontractors a reasonable opportunity for the introduction and storage of their materials and the execution of their Work and shall properly connect and coordinate its Work with others.

Contractor shall strictly adhere to the Schedule unless changed as provided for in the following paragraph.

- 2) Within five (5) days after receiving notice of any change in the Contract, or of any Extra Work to be performed, or of any suspension of the whole or any portion of the Work, or of any other conditions which are likely to cause or are actually causing delays, Contractor must notify the Construction Administrator in writing of the effect, if any, of such change or Extra Work or suspension or other condition upon the previously approved schedule, and must state in what respects, if any, the Schedule should be revised, with the reasons therefor. These proposed changes in the Schedule shall be reviewed and, if appropriate, approved, in writing, by the Construction Administrator. Contractor must strictly adhere to the revised Schedule. Distribution of the revised Schedule shall be as described in paragraph B-1 above. Contractor's compliance with the requirements of this paragraph is in addition to, and not in lieu of, compliance with other notice requirements pertaining to delays and extensions of time contained elsewhere in the contract.
 - 3) The Schedule shall be reviewed by Contractor every two (2) weeks or as directed by the Construction Administrator.
 - 4) If Contractor shall fail to adhere to the approved Schedule, or to the Schedule as revised, they must promptly adopt additional means and methods of construction with no additional cost to the County that will make up for the lost time and will assure completion in accordance with such Schedule. The proposed means and methods shall be described in writing to the County within two (2) days after the Contractor discovered or should have reasonably discovered that the Schedule would not be met as originally proposed. Failure to comply with this requirement may result in the County enforcing its rights under the Contract including, without limitation, default of the Contract.
- C. From time to time as the Work progresses and in the sequence indicated by the approved Schedule, the Contractor must submit to the Construction Administrator a specific request in writing for each item of information or approval required. These requests shall be submitted sufficiently in advance of the date upon which the information or approval is actually required by the Contractor to allow for the time the Construction Administrator may reasonably take to act upon such submissions or resubmissions. The Contractor shall not have any right to an Extension of Time on account of delays due to its failure to timely submit requests for the information or approvals.
- D. Certain construction work shall be required, which will be disruptive to the Owner's staff insofar as noise, dirt and dust is concerned. The Contractor, therefore, shall

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perform such work during other than normal working hours. Subject to the requirements of law, the Owner imposes no limitation on the Contractor's working hours and whatever overtime work may be necessary or required shall be considered by the Contractor and reflected in its Bid Proposal without the benefit of extra compensation.

46. PROTECTION

- A. The Contractor shall at all times exercise all necessary precautions for the safety of the public, employees performing the work and County personnel. The Contractor shall provide and maintain barricades, danger signals and other safeguards about the work and shall be held responsible for all accidents or damages to persons or property caused by failure to do so throughout the progress of the work, and shall comply with all applicable provisions of Federal, State and County Safety Laws.
- B. The Contractor shall during the performance of its work, protect at all times all adjacent portions of the existing surfaces and existing equipment from damage due to the performance of the construction work.
- C. The Contractor shall furnish temporary facilities and/or temporary dust-proof partitions separating all work areas and access routes from those areas not involved in active alterations, so that this work will not interfere with the Owner's access or normal use of areas not allocated to the Contractor, or any essential service to such areas, when ordered by the Construction Administrator.

47. CLEANUP AND REMOVAL OF DEBRIS

- A. At the end of each working day, the Contractor shall sweep up and collect all the rubbish and place it in appropriate containers, furnished by the Contractor. Containers shall be kept at a location on, or adjacent to the work site, as designated by the Construction Administrator. Wood or cardboard crates and other debris of a similar nature shall be broken up, securely bundled and neatly stacked alongside the containers. Once each week and at the completion of the work, the Contractor shall remove all accumulated debris and rubbish.
- B. At the completion of the work, the Contractor shall clean all equipment, fixtures, surfaces and accessories, removing all dust and other foreign matter, ready for use by the Owner.

48. TEMPORARY SERVICE

- A. Sanitary facilities will be provided by the Owner for the Contractor and its personnel.
- B. The Owner will supply and pay for the cost of all-temporary water and temporary electric power (120 volt, 60 hertz). The Contractor shall furnish and install all temporary electrical and water connections required for work under this Contract, at and to locations as designated by the Construction Administrator.

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49. OPERATING TESTS

- A. Where operating tests are specified the Contractor shall test the work as it progresses and shall make satisfactory preliminary tests in all cases before applying to the Engineer for official tests.
- B. Official tests will be made in the manner specified for the different branches of the work, in the presence of the Construction Administrator or Engineer. Should defects appear they shall be corrected by the Contractor and the test repeated until the installation is acceptable to the Construction Administrator or Engineer and to any authorities having jurisdiction.
- C. No work of any kind shall be covered or enclosed before it has been tested and approved.
- D. The Contractor shall furnish all materials and apparatus, make connections and conduct tests, without extra compensation unless noted otherwise.

50. OPERATING INSTRUCTIONS AND PARTS LISTS

- A. Where the Specifications require any Contractor to supply equipment operating and maintenance instructions and spare parts lists prior to the completion of the work it shall provide three copies of the publications for each piece of equipment he has furnished and installed under the Contract, upon receipt of the approved shop drawings.
- B. Publications shall be prepared for the specific equipment furnished and installed, containing the following information, and shall not refer to other sizes, types or models of similar equipment:
 - 1) Clear and concise instructions for the operation, adjustment, lubrication and other maintenance of the equipment, including a complete lubrication chart.
 - 2) A complete listing of all parts for the equipment, with catalog numbers and other data necessary for ordering replacement parts.
- C. Advertising literature will not be acceptable.

51. CUTTING AND PATCHING

Contract with Single Bid:

- A. Where the project does not involve separate bids pursuant to the New York General Municipal Law the following will apply:
 - 1) Where walls, floors, ceilings, roofs or other items require cutting for the installation of new work, all such cutting shall be done by the Contractor with the approval of the Construction Administrator; and the Contractor shall patch the opening to make the cut portions match the adjacent finished surfaces, unless otherwise indicated.
 - 2) The Contractor shall not endanger any existing condition by its operations.
 - 3) The cost of all cutting and patching caused by the Contractor's negligence shall be

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borne by the Contractor.

Contract with Separate Bids:

- B. If the project is one where separate bid specifications are required pursuant to the New York General Municipal Law the following will apply:
- 1) A sufficient time in advance of the construction of new floors, walls, ceilings, roofs, or other items, each Contractor shall be responsible for properly locating and providing in place all sleeves, inserts and forms required for their work, and shall furnish the Contractor for General Construction with complete information relative to exact locations and dimensions of all required openings in the General Contractor's work. Other Contractors shall periodically consult the Job Progress Chart of the General Contractor so that they will not be delayed by their work requirements, but the General Contractor shall be obliged to give all other Contractors at least seventy-two hours notice before commencing the previously mentioned new construction work.
 - 2) The cost shall be borne by the responsible Contractor for all cutting, patching, re-waterproofing and re-caulking of new work necessary for reception of the work of a Contractor, caused by the Contractor's failure to timely or properly locate and provide in place all sleeves, inserts and forms required for its own work, or by a Contractor's failure to inform the General Contractor of required openings. The General Contractor shall do all cutting, patching, re-waterproofing and re-caulking of all new work no matter how or by whom such work was caused and shall be reimbursed for such extra work by the responsible Contractor, in accordance with the terms of the Contract. All cutting and patching shall have prior approval of the Construction Administrator.
 - 3) Where sleeves, inserts, forms or openings are required in existing walls, floors, ceilings roofs, or other existing items, all necessary cutting, patching, re-waterproofing and re-caulking required shall be done by the individual responsible Contractor, except for finished surfaces. The responsible Contractor shall do all rough patching to bring the cut areas to the proper surface ready to receive the finished surface. All finishing work required to make the cut portions match the adjacent finished surfaces shall be performed by the General Contractor.
 - 4) Each Contractor shall be responsible for coordinating their work with the work of all other Contractors engaged on the project. If directed, Contractors shall submit coordinated shop drawings showing how the fitting of the various parts of the work will be accomplished, for the Construction Administrator's acceptance.
 - 5) All cutting and patching shall be governed by the applicable divisions of the Specifications with regard to workmanship, materials and methods.
 - 6) No Contractor shall endanger any work by unauthorized cutting, excavating, or other alteration of the work, unless previously authorized by the Construction Administrator.

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52. CONFLICTS AMONG CONTRACT DOCUMENTS

In the event of any conflict among the Contract Documents, the Contractor shall notify the Commissioner and comply with the Commissioner's interpretation, according to the following priorities:

<u>Priority Order</u>	<u>Document</u>
1.....	Modification issued after execution of Agreement
2.....	Agreement between Owner and Contractor
3.....	Addenda issued prior to the execution of the Agreement (Later date to take precedence)
4.....	Special Notices
5.....	Technical Specifications
6.....	Construction Drawings:
6A.....	Schedule on Construction Drawings
6B.....	Notes on Construction Drawings
6C.....	Large Scale Details on Construction Drawings
6D.....	Small Scale Details on Construction Drawings
7.....	General Requirements
8.....	Special Clauses
9.....	Information for Bidders and General Clauses

53. RECORD DRAWINGS

- A. The Owner shall furnish, at the first job meeting, one set of "paper" copies of the contract drawing(s) - this is in addition to the five sets of contract drawings as described in the Article "Contract Drawings" of the General Requirements; for the Contractor's use to indicate change(s) as they occur for the duration of the construction work. Upon request from the Contractor, the County will supply the Contractor a copy of the original Contract Drawings in AutoCAD format.
- B. The Contractor shall record neatly and legibly, using reasonable drafting care, all approved change(s) (including minor revisions or corrections of pipes, ducts, electric outlets, circuit panels and other features, as well as invert elevations and locations of underground lines).
- C. When all approved changes are recorded and clearly identified, the Contractor shall prepare a set of "as-built" (record) drawings, in the latest version of AutoCAD, using the approved County format and associated CAD layering guidelines, with 24" x 36" drawing sizes, showing the project as built including all changes in the work made during construction based on marked-up prints, drawings, and other data. These drawings shall be filed on a CD and submitted to the Construction Administrator.
- D. All additional "paper" or reproducible drawings are to be obtained by the Contractor at their own expense.

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54. TIME

- A. All time limits (see Article “Required Time For Completion Of The Work” of the General Requirements, and, Article “Time Of Starting” of the Information For Bidders) stated in the specifications are of the essence of the Contract.
- B. The Contractor may perform all necessary labor during other than normal working hours. The Owner imposes no limitation of the Contractor's working hours and whatever overtime work may be necessary or required shall be considered by the Contractor and reflected in its Bid Proposal without the benefit or extra compensation. The Contractor must give a minimum of four (4) hours notice to the Construction Administrator when overtime Work is necessary. The Contractor shall promptly pay to the County the additional cost of the Engineer and Construction Administrator for inspection services during the overtime Work.

55. ACCELERATION OF THE WORK

The Owner may, at its sole discretion and for any reason, require the Contractor to accelerate the schedule of performance by providing overtime, extended day, extra crews, Saturday, Sunday and/or holiday work and/or by having all or any subcontractors designated by the Owner provide overtime, extended day, extra crews, Saturday, Sunday or holiday work by the Contractor’s or his subcontractor’s own forces, and such requirements is independent of and not related in any way to any apparent inability of the Contractor to comply with the schedule(s), Milestone(s) and/or completion date requirements, the Owner, pursuant to a written change order as signed by the Commissioner shall reimburse the Contractor for the direct cost to the Contractor of the premium time for the labor utilized by the Contractor in such overtime, extended day, extra crews, Saturday, Sunday or holiday work (but not for the straight time costs of such labor) together with any social security and state or federal unemployment insurance taxes in connection with such premium time. However, no overhead, supervision costs, commissions, profit or other costs and expenses of any nature whatsoever, including impact costs or costs associated with lost efficiency or productivity, shall be payable in connection therewith. Anything to the foregoing notwithstanding, in the event that the Contractor has fallen behind schedule or in the Owner’s judgment appears likely to fall behind schedule, Owner shall have the absolute right to direct the Contractor to accelerate the performance of its work, including that of its subcontractors, and the full costs for such acceleration shall be borne solely by the Contractor.

56. ULTRA LOW SULFUR DIESEL FUEL

- A. Contractors and Subcontractors operating onroad and nonroad vehicles to perform County work must power those vehicles with ultra low sulfur diesel fuel. Ultra low sulfur diesel fuel is any diesel fuel that has a sulfur content of no more than fifteen parts per million.
- B. In addition, all onroad and nonroad diesel vehicles used to perform County work and equipped with a model year 2003 or older engine shall utilize the best available

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technology² in accordance with the following schedule:

- a) effective September 1, 2007 - 35% of all such motor vehicles used on this project;
 - b) effective September 1, 2008 - 65% of all such motor vehicles used on this project;
 - c) effective September 1, 2009 - 100% of all such motor vehicles used on this project.
- C. All onroad and nonroad diesel vehicles to perform County work having a gross vehicle weight rating of more than 14,000 pounds shall utilize the best available technology or be equipped with an engine certified to the applicable 2007 United States Environmental Protection Agency (“EPA”) standard for particulate matter as set forth in Section 86.007-11 of Title 40 of the Code of Federal Regulations or to any subsequent EPA standard for such pollutant that is at least as stringent, in accordance with the following schedule:
- a) by September 1, 2007 - 35% of all such motor vehicles;
 - b) by September 1, 2008 - 65% of all such motor vehicles;
 - c) by September 1, 2009 - 100% of all such motor vehicles
- D. Any contractor who violates any provision of Section 873.1329 shall be liable for a civil penalty not to exceed ten thousand dollars plus twice the amount of money saved by such contractor for failure to comply with this section.
- E. Any contractor who makes a false claim may be liable for a civil penalty not to exceed twenty thousand dollars, in addition to twice the amount of money saved by such contractor as a result of having made such false claim.
- F. Nothing in this section shall be construed to limit the County’s authority to cancel or terminate a contract, deny or withdraw approval to perform a subcontract or provide supplies, issue a non-responsibility finding, issue a non-responsiveness finding, deny a person or entity pre-qualification as a vendor, or otherwise deny a person or entity public entity business.
- G. If sufficient quantities of ultra low sulfur diesel fuel are not available to meet the needs of a contractor to fulfill the requirements of this contract, the Contractor may submit a written request to the Commissioner to use diesel fuel with a sulfur content of no more than thirty parts per million as long as the contractor shall use whatever quantity of ultra low sulfur diesel fuel that is available. Such determination shall be made in writing on a case by case basis upon written application to the Commissioner. If the Commissioner grants such authority it shall expire sixty days thereafter and may be renewed upon written request for additional periods of sixty days.

² Best Available Technology means a system for reducing the emission of pollutants which is based on technology verified by the U.S. Environmental protection Agency or the California Air Resources Board or which has been identified pursuant to NYC’s Department of Environmental Protection that (1) reduces diesel particulate matter emissions by at least 85 percent, as compared to a similar engine operating on traditional diesel fuel without emission control technology, or reduces engine emissions to 0.01 grams diesel particulate matter per brake horsepower per hour or less; and 2) achieves the greatest reduction in emissions of nitrogen oxides at a reasonable cost and in no case produces a net increase in nitrogen oxides in excess of 10%.

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H. The Contractor, in order to comply with Subsections B & C above, must retrofit its vehicles to include both of the following in order to comply with the Best Available Technology Requirements:

- Diesel Oxidation Catalysts (DOC)
- Crankcase Vent Filters (CVF)

If the Contractor wants to propose an alternative technology it must submit a written request to the Commissioner with sufficient detail to enable the Commissioner to make a determination as to whether to accept the alternative technology. Any approval of alternative technology must be in writing.

57. QUALIFIED TRANSPORTATION FRINGE PROGRAM

EXECUTIVE ORDER NO. 7-2005

Requires that contractors, concessionaires and vendors doing business with the County enroll in a Qualified Transportation Fringe Program as defined in §132(f)(1) of the IRS Tax Code for all contracts for goods or services of \$100,000 or more in any twelve month period during the contract term if such contractor, concessionaire or vendor employs more than 25 individuals who utilize public transportation and/or pay for commuter parking at least 1 day per week regardless of whether those employees are engaged in work pursuant to the contract.

Bidders shall submit the signed statement on Proposal Page 34. Notwithstanding the above, a Bidder may submit a Waiver Application on Proposal Page 35 to the Commissioner.

58. USE OF FLUORESCENT LIGHT BULBS & ENERGY EFFICIENT BULBS

The use of incandescent light bulbs is prohibited in County-owned buildings and facilities. Only fluorescent light bulbs may be installed in County buildings and facilities. Exterior lights must utilize energy-efficient bulbs. For further details see Article 58 of the General Clauses.

59. COUNTY OF WESTCHESTER PHOSPHORUS-FREE LAWN FERTILIZER POLICY

Executive Order 8-2007 limits the use of lawn fertilizers containing phosphorous and other compounds containing phosphorous, such as phosphate on County owned property.

EXECUTIVE ORDER NO.8 OF 2007

WHEREAS, the New York City water supply watershed is a critical drinking water source for approximately eight million New York City consumers and approximately one million upstate consumers. Over eighty-five percent (85%) of Westchester County's residents consume water from the New York City water supply system; and

WHEREAS, eutrophication is a natural aging process of lakes or streams brought on by

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nutrient enrichment. Eutrophication can be greatly accelerated by human activities that increase the rate at which nutrients and organic substances enter aquatic ecosystems from their surrounding watersheds; and

WHEREAS, as a result of accelerated eutrophication, enhanced plant growth reduces dissolved oxygen in the water creating severely impaired water bodies with unpleasant water taste and odor, discoloration, release of toxins and increased turbidity that interferes with the health and diversity of indigenous fish, plant, and animal populations and with the recreational use of rivers, lakes and wetlands. Consequently, eutrophication restricts water use for fisheries, recreation, industry, and drinking due to the increased growth of undesirable algae and aquatic weeds and the oxygen shortages caused by their death and decomposition; and

WHEREAS, nutrient pollution due to human activities is one of the leading causes of eutrophication in the NYC Watershed, and is specifically accelerated by the introduction of excessive phosphorus into the environment. In fact, most reservoirs in the East of Hudson portion of the New York City Watershed (5 of the 7 located in Westchester County) are designated as phosphorous-restricted basins in accordance with the New York City Watershed Rules & Regulations due to excessive phosphorous volumes which have not been reduced despite phosphorous reductions mandated by the New York State Department of Environmental Conservation (NYSDEC); and

WHEREAS, one unnecessary source of phosphorus pollution in the watershed is the many pounds of lawn fertilizer applied by residents and businesses in the County of Westchester each year; and

WHEREAS, when phosphorus fertilizer is applied to phosphorus-rich lawns, much of the excess simply runs off of the lawn into the storm drainage systems where it can be carried into rivers, lakes, streams, and wetlands, causing eutrophication; and

WHEREAS, soil tests conducted pursuant to a six-year study by the Cornell Cooperative Extension, an extension of the State's designated Land-Grant University, have shown that approximately 90% of the lawns in Westchester County have medium-to-high levels of phosphorus; and

WHEREAS, the New York City Watershed Pesticide and Fertilizer Technical Working Group, established by the New York City Watershed Memorandum of Agreement, issued a report in 2000, noting the high percentage of phosphorus in regional soils and recommending that phosphorus-based lawn fertilizers be added only when a soil analysis identifies phosphorus deficiencies.

WHEREAS, the proposed Stormwater Phase II regulations recently issued by the New York State Department of Environmental Conservation, and which are expected to go into effect in January of 2008, will allow the use of phosphorus-based lawn fertilizers on municipally-owned land only where soil testing indicates that phosphorus concentrations are inadequate, in order to ensure that municipalities in the New York City Watershed are

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taking satisfactory steps to achieve the above-referenced mandatory phosphorous reductions.

WHEREAS, the United States Environmental Protection Agency has also determined that a Nonpoint Source Implementation Plan was necessary in the Croton Watershed because the phosphorus reductions necessary to meet the targeted applicable water quality standards could not be achieved by wastewater treatment plant upgrades alone; and

WHEREAS, Section 110.11 of the Laws of Westchester County places the responsibility to supervise, direct and control, subject to law, the administrative services and departments of the county, upon the County Executive; and

WHEREAS, I have determined that restricting the application and use of lawn fertilizer containing phosphorus on all County-owned property will address one source of unnecessary and preventable phosphorus pollution and will improve water quality in the County; and

WHEREAS, the Department of Planning, after review of the applicable regulations under the State Environmental Quality Review Act, has advised that this Executive Order has been classified as a Type II action, pursuant to 6 N.Y.C.R.R. § 617.5(c)(20), “routine or continuing agency administration and management, not including new programs or major reordering of priorities that may affect the environment,” and 6 N.Y.C.R.R. § 617.5(c)(27), “adoption of regulations, policies, procedures and local legislative decisions in connection with any action on this list.” As such, no further environmental review is required.

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NOW THEREFORE, I, _____, County Executive of the County of Westchester, in light of the aforementioned, do hereby order and direct each and every department, board, agency, and commission of the County of Westchester under my jurisdiction to ensure that the policies and procedures set forth in the following Phosphorus-Free Lawn Fertilizer Policy are complied with.

COUNTY OF WESTCHESTER
PHOSPHORUS- FREE LAWN FERTILIZER POLICY

I. Definitions:

(1) "Certified laboratory" means any laboratory certified by the New York State Department of Health pursuant to section five hundred two of the New York State Public Health Law to conduct soil analysis.

(2) "Commercial fertilizer" means any substances containing one or more recognized plant nutrients which is used for its plant nutrient content, and which is designed for use or claimed to have value in promoting plant growth, except unmanipulated animal or vegetable manures, agricultural liming material, wood ashes, gypsum and other products exempted by regulation of the New York State Commissioner of Agriculture and Markets.

(3) "Lawn fertilizer" means a commercial fertilizer distributed primarily for non-farm use, such as lawns, shrubbery, flowers, golf courses, municipal parks, cemeteries, greenhouses and nurseries, and such other use as the commissioner may define by regulation. Lawn fertilizer does not include fertilizer products intended primarily for garden and indoor plant application.

II. Use and Application of Lawn Fertilizer:

(1) Any lawn fertilizer that is labeled as containing more than 0% phosphorus or other compound containing phosphorus, such as phosphate, shall not be applied upon any County-owned property, except as provided in section III. Of this Executive Order.

(2) No lawn fertilizer shall be applied upon County-owned property when the ground is frozen.

(3) Lawn fertilizer shall not be applied to any impervious surface upon County-owned property, including parking lots, roadways, and sidewalks. If such application occurs, the fertilizer must be immediately contained and either applied to turf in a manner consistent with this Executive Order or placed in an appropriate container.

III. Exemptions:

The prohibition against the use of lawn fertilizer under section II of this Executive Order shall not apply to:

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(1) Newly established turf or lawn areas during their first growing season.

(2) Turf or lawn areas that soil tests, performed within the past three years by a certified laboratory or by the Cornell University Cooperative Extension of Westchester County, confirm the need for additional phosphorus application in accordance with the phosphorus levels established by the Cornell University Cooperative Extension of Westchester County. The lawn fertilizer application shall not contain an amount of phosphorus exceeding the amount and rate of application recommended in the soil test evaluation.

(3) Agricultural uses, vegetable and flower gardens, or application to trees or shrubs.

IV. The transition to phosphorus-free lawn fertilizer shall occur as soon as possible in a manner that avoids wasting of existing inventories; accommodates establishment of supply chains for new products; enables the training of County employees and licensees in appropriate work methods; and allows the phase-out of products and practices inconsistent with this Executive Order. However, in no event shall lawn fertilizer containing phosphorus (i.e., labeled as containing more than 0% phosphorus or other compound containing phosphorus, such as phosphate) be applied upon County-owned property after January 1, 2009, unless an exemption set forth in Section III of this Executive Order applies.

V. This Executive Order shall take effect on the date hereof, and shall remain in effect until otherwise superseded, repealed, modified or revoked.



SAMPLE FORMS

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

SAMPLE FORMS

AFFIRMATIVE ACTION PROGRAM REQUIREMENT- SUBCONTRACTOR(S)

County of Westchester, Department of Public Works

(To Be Completed By Subcontractor and Submitted with Request to Utilize Subcontractor)

Affirmative Action Program

An approved Affirmative Action Plan shall be required for all Subcontractors for public work where the subcontracted work exceeds \$50,000 or more than fourteen (14) persons are employed by the Subcontractor.

Does the Subcontractor participate in an approved Affirmative Action Program? Yes [] No []

If Yes, give name of Program: _____

If No, how many employees will the Subcontractor employ on this project? _____

An approved Affirmative Action Program shall mean a plan approved or adopted by Westchester County including but not limited to, the Home-Town Plan, the Recruitment Training Program or any other program approved or meeting the requirements of the State or Federal government.

The "Monthly Employment Utilization Report" of the Sample Forms, shall be filled out by the Contractor and/or Subcontractor(s) who are required to have an Affirmative Action Program, prior to the start of the work.

SAMPLE FORMS

CONTRACTOR'S REPORT OF EMPLOYMENT AND WEEKLY AFFIDAVIT

County of Westchester, Department of Public Works

Contract No. _____

Report No. _____

Week(s) ending _____

Title of Contract and Location _____

Contractor or Subcontractor _____

Address _____

STATE OF _____)
COUNTY OF _____) SS.:

I, _____, being duly sworn, depose and say:

1. I pay or supervise the payment of the persons employed by _____
(Contractor or Subcontractor)

in connection with the above referenced contract;

2. During the payment period commencing on the ____ day of _____,
20____ and ending on the _____ day of _____, 20____, all persons employed by
_____ in connection with such contract have been paid in full
(Contractor or Subcontractor)

weekly wages and supplements earned by such persons except the following: (strikeout, if not applicable)

3. Such persons have been paid the prevailing rate of wages and the supplements as determined and required by Section 220 of the New York State Labor Law.

SAMPLE FORMS

4. No rebates or deductions have been deducted from such wages and supplements except as authorized or required by applicable statutes or regulations of the Federal, State and County Governments.

5. The following is a true and accurate summary of wages and supplements paid:

_____ During the week _____ Total to date

Number of names on payroll _____

Hours worked _____

Total wages earned _____

6. I have read the foregoing statement of wages and supplement, know the contents thereof, and the same is true to my own knowledge.

(Signature)

STATE OF NEW YORK)
COUNTY OF WESTCHESTER) ss.:

On this _____ day of _____, 20___, before me personally came _____ to me known, and known to me to be the person who executed the above instrument, and who being duly sworn did say that he executed the same.

Sworn to before me
this _____ day of _____

License No.

Notary Public - State of New York

SAMPLE FORMS

MONTHLY EMPLOYMENT UTILIZATION REPORT
County of Westchester, Department of Public Works

<u>MONTHLY EMPLOYMENT UTILIZATION REPORT</u>										CONTRACT NO.:				
JOB TITLE:										REPORTING PERIOD:				
NAME AND LOCATION OF CONTRACTOR:										FROM: _____				
NAME AND LOCATION OF CONTRACTOR:										TO: _____				
WORK HOURS OF EMPLOYMENT										TOTAL NUMBER OF EMPLOYEES				
CONSTRUCTION TRADE	CLASSIFICATION	TOTAL ALL EMPLOYEES BY TRADE			BLACK (NOT HISPANIC ORIGINAL)	HISPANIC			ASIAN OR PACIFIC ISLANDERS	AMERICAN INDIAN OR ALASKAN NATIVE	MINORITY PERCENTAGE %	FEMALE PERCENTAGE %	TOTAL NUMBER OF MINORITY EMPLOYEES	
		M	F	HRS		M	F	M					F	M
	JOURNEY WORKER													
	APPRENTICE													
	TRAINEE													
	SUB-TOTAL													
	JOURNEY WORKER													
	APPRENTICE													
	TRAINEE													
	SUB-TOTAL													
	JOURNEY WORKER													
	APPRENTICE													
	TRAINEE													
	SUB-TOTAL													
	JOURNEY WORKER													
	APPRENTICE													
	TRAINEE													
	SUB-TOTAL													
	TOTAL JOURNEY WORKER													
	TOTAL APPRENTICES													
	TOTAL TRAINEES													
	GRAND TOTAL (#HRS & #EMPL)													
COMPANY OFFICIAL'S SIGNATURE AND TITLE:										DATE SIGNED:		PAGE: _____ OF _____		

This report must be filled out by all contractors (both prime and sub) who are required to have an Affirmative Action Program, and must be filed with the Engineer by the 5th day of each month during the term of the Contract, and shall include the total work hours of each employee classification in each trade in the covered area for the Monthly Reporting Period. The Prime Contractor shall submit a report for its Aggregate Work Force and collect and submit reports for each subcontractor's Aggregate Work Force to the Engineer.

SAMPLE FORMS

SHOP DRAWING SCHEDULE
County of Westchester, Department of Public Works

SHOP DRAWING SCHEDULE											
SPECIFICATION NUMBER	DESCRIPTION OF ITEM/MODEL #	SUBMISSION	REQUEST FROM CONTRACTOR TO MANUFACTURER	RECEIVED BY CONTRACTOR FROM MANUFACTURER	RECEIVED BY COUNTY FROM CONTRACTOR	RETURNED BY COUNTY TO CONTRACTOR	RETURNED BY CONTRACTOR TO MANUFACTURER	APPROVED BY COUNTY	APPROVED SHOP DRAWING MANAGER FROM CONTRACTOR	INVOICE NO. AND SCHEDULED DELIVERY DATE	ACTUAL DELIVERY DATE
		ORIGINAL									
		2									
		3									
		4									
		ORIGINAL									
		2									
		3									
		4									
		ORIGINAL									
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		3									
		4									
		ORIGINAL									
		2									
		3									
		4									

SAMPLE FORMS

SHOP DRAWING ID

County of Westchester, Department of Public Works

WESTCHESTER COUNTY DRAWING _____ OF _____

NAME OF PROJECT

Date _____

Contract No. _____

Item/Model No. _____

Manufacturer _____

Contract Drawing No. _____

Specification Section _____

This document has been reviewed, coordinated and checked for accuracy of content and for compliance with the Contract Documents. The information contained herein has been coordinated with all other Contract Work.

Contractor _____

Signed _____

SAMPLE FORMS

REQUEST FOR APPROVAL OF EQUAL

County of Westchester, Department of Public Works

SPECIFICATION
NO.

ITEM

EQUAL

Attach a separate sheet here if more space is required.

SAMPLE FORMS

REQUEST FOR APPROVAL OF SUBSTITUTIONS

County of Westchester, Department of Public Works

<u>ITEM NO.</u>	<u>ITEM</u>	<u>SUBSTITUTION</u>	<u>COST OF SPECIFIED ITEM</u>	<u>COST OF SUBSTITUTED ITEM</u>	<u>SAVINGS TO COUNTY</u>

Attach a separate sheet here if more space is required.

SAMPLE FORMS

CONTRACTOR'S ULTRA LOW SULFUR DIESEL FUEL AFFIDAVIT

County of Westchester, Department of Public Works

Contract No. _____ Period Included in this Report: _____, 20__ to _____, 20__

Title of Contract and Location _____

Contractor _____

Address _____

Subcontractor _____

Address _____

STATE OF _____) ss.:
COUNTY OF _____)

I, _____ being duly sworn, depose and say:
(print name) (print title)

1. I certify under penalty of perjury that I agree to comply with the requirements of Chapter 878, Article XIII, Section 873.13.29 of the Laws of Westchester County.
2. During the period _____ through _____, all diesel-powered vehicles, used in the performance of Contract No. _____, were powered by ultra low sulfur diesel fuel (15 ppm Sulfur Maximum).
3. No fuel other than Ultra Low Sulfur Diesel Fuel (15 ppm Sulfur Maximum) was utilized on this project for the above described vehicles.
4. The annexed Ultra Low Sulfur Diesel Fuel Log is a true and accurate summary of the low sulfur diesel fuel (15 ppm Sulfur Maximum) purchased and utilized in the performance of this project.
5. I have read the foregoing statement, have full knowledge of the contents thereof, and it is my intent that the County of Westchester will rely on the statements contained herein.

(Signature)

STATE OF _____) ss.:
COUNTY OF _____)

On this _____ day of _____, 20__, before me personally came _____ to me known, and known to me to be the person who executed the above instrument, and who being duly sworn did say that he/she executed the same.

Sworn to before me this

_____ day of _____, 20__.

Notary Public

The Ultra Low Sulfur Diesel Fuel-Log must be attached.

This Certification also has to be submitted by your subcontractor(s). *Additional copies of this form can be acquired from the Department of Public Work.*

SAMPLE FORMS

ULTRA LOW SULFUR DIESEL FUEL (15 ppm Sulfur Maximum) – LOG

Period of Log: _____ through _____

Contract No. _____

Title of Contract and Location _____

Contractor or Subcontractor _____
Address _____

Date of Purchase	Name and Address of Vendor (Print)	Gallons Purchased

A Separate Copy of this Certification will also have to be signed by each of your subcontractors that utilize diesel powered vehicles, fifty horsepower or greater, on the above project. Additional copies of this form can be acquired from the Department of Public Works.

- New
 Change
 No Change

Electronic Funds Transfer (EFT) Vendor Direct Payment Authorization Form

INSTRUCTIONS: Please complete both sections of this Authorization form and attach a voided check. See the reverse for more information and instructions (Forms Page 21). If you previously submitted this form and there is no change to the information previously submitted, **ONLY** complete lines 1 through 6 of section 1.

Section I - Vendor Information

1. Vendor Name:

2. Taxpayer ID Number or Social Security Number:

--	--	--	--	--	--	--	--	--	--

3. Vendor Primary Address

4. Contact Person Name:

Contact Person Telephone Number:

5. Vendor E-Mail Addresses for Remittance Notification:

6. Vendor Certification: *I have read and understand the Vendor Direct Payment Program and hereby authorize payments to be received by electronic funds transfer into the bank that I designate in Section II. I further understand that in the event that an erroneous electronic payment is sent, Westchester County reserves the right to reverse the electronic payment. In the event that a reversal cannot be implemented, Westchester County will utilize any other lawful means to retrieve payments to which the payee was not entitled.*

Authorized Signature

Print Name/Title

Date

Section II- Financial Institution Information

7. Bank Name:

8. Bank Address:

9. Routing Transit Number:

--	--	--	--	--	--	--	--	--	--

10. Account Type:
(check one)

Checking

Savings

11. Bank Account Number:

12. Bank Account Title:

13. Bank Contact Person Name:

Telephone Number:

14. FINANCIAL INSTITUTION CERTIFICATION (required **ONLY** if directing funds into a Savings Account **OR** if a voided check is not attached to this form): *I certify that the account number and type of account is maintained in the name of the vendor named above. As a representative of the named financial Institution, I certify that this financial Institution is ACH capable and agrees to receive and deposit payments to the account shown.*

Authorized Signature

Print Name / Title

Date

**(Leave Blank - to be completed by
Westchester County) - Vendor number assigned**

--	--	--	--	--	--	--	--	--	--

Electronic Funds Transfer (EFT) Vendor Direct Payment Authorization Form

GENERAL INSTRUCTIONS

Please complete both sections of the Vendor Direct Payment Authorization Form and forward the completed form (along with a voided check for the account to which you want your payments credited) to: Westchester County Board of Acquisition and Contract, 148 Martine Ave, Room 104, White Plains, NY 10601, Attention: Vendor Direct. Please see item 14 below regarding attachment of a voided check.

Section I - VENDOR INFORMATION

1. Provide the name of the vendor as it appears on the W-9 form.
2. Enter the vendor's Taxpayer ID number or Social Security Number as it appears on the W-9 form.
3. Enter the vendor's complete primary address (not a P.O. Box).
4. Provide the name and telephone number of the vendor's contact person.
5. Enter the business e-mail address for the remittance notification. THIS IS VERY IMPORTANT. This is the e-mail address that we will use to send you notification and remittance information two days prior to the payment being credited to your bank account. We suggest that you provide a group mailbox (if applicable) for your e-mail address. You may also designate multiple e-mail addresses.
6. Please have an authorized Payee/Company official sign and date the form and include his/her title.

Section II - FINANCIAL INSTITUTION INFORMATION

7. Provide bank's name.
8. Provide the complete address of your bank.
9. Enter your bank's 9 digit routing transit number.
10. Indicate the type of account (check one box only).
11. Enter the vendor's bank account number.
12. Enter the title of the vendor's account.
13. Provide the name and telephone number of your bank contact person.
14. If you are directing your payments to a Savings Account OR you can not attach a voided check for your checking account, this line needs to be completed and signed by an authorized bank official. IF YOU DO ATTACH A VOIDED CHECK FOR A CHECKING ACCOUNT, YOU MAY LEAVE THIS LINE BLANK.



SAMPLE CONTRACT AND BOND
FOR CONSTRUCTION

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

WESTCHESTERGOV . COM

**DEPARTMENT OF PUBLIC WORKS
OFFICE OF THE COMMISSIONER**

CONTRACT AND BOND

FOR CONTRACT

NOTE: ONLY PROVIDED AS A SAMPLE IN THESE SPECIFICATIONS FOR INFORMATIONAL PURPOSES AND NOT TO BE EXECUTED WHEN SUBMITTING THE BID PROPOSAL. THE SUCCESSFUL BIDDER WILL BE REQUIRED TO EXECUTE THESE DOCUMENTS, AS MORE FULLY DESCRIBED IN THE PROPOSAL REQUIREMENTS.

CONTRACT NO.

Amount of Contract \$

THIS AGREEMENT made this ____ day of _____, 200__, by and between the COUNTY OF WESTCHESTER, a municipal corporation of the State of New York, hereinafter, "County", and

hereinafter called the "Contractor", WITNESSETH as follows:

WHEREAS, the Commissioner of Public Works, hereinafter called "Commissioner", by virtue of the power and authority in him vested did advertise for proposals and bids for:

Westchester County, New York, to furnish all labor, tools, implements and materials that may be requisite and necessary to the execution and completion of the work according to the plans, specifications, profiles and other drawings relating to such work, as approved by the County of Westchester and now on file in the Office of the Commissioner, and

WHEREAS, the Contractor did bid for said work in the manner and form as required by said plans and specifications and, being the lowest responsible bidder therefore, was duly awarded the Contract for such work at prices named in the itemized proposal by a resolution of the Board of Acquisition and Contract of the said County of Westchester.

NOW THEREFORE, the Contractor, in consideration of the prices so named for the various items of work to be paid for as hereinafter provided, does for itself, its representatives, agents, executors, administrators, successors or assigns, covenant and agree with the County that it, the said Contractor, shall and will at its own proper costs and charges and in conformity with said plans and specifications which are made a part of this Contract without setting forth same herein, provide all manner and kind of materials, molds, models, cartage, appliances and appurtenances required and of every description necessary for the due and proper performance of this Contract and the completion of said work to be done under the supervision and direction of the Commissioner, in a good workmanlike manner and in conformity with said plans and specifications without any alteration, deviation, additions, or omissions therefrom except upon due request and under the written direction of said Commissioner.

The Contractor acknowledges receipt of the "Information for Bidders, General and Special Clauses, Specification, Proposal and Plans" relating to this Contract, as well as all issued Addenda thereto, all of which are expressly incorporated in this Contract as if fully set forth herein.

IT IS FURTHER UNDERSTOOD AND AGREED by and between the parties to this Contract that if in the opinion of the said Commissioner of the County of Westchester it shall become necessary to make any change in the work called by the plans and specifications which are a part of this Contract, whereby, consistent with the Information for Bidders, the work contemplated by said plans and specifications is modified and reduced and the costs and expenses of such work lessened, that then and in that event the Contractor will do the work as changed and modified and the said Commissioner shall estimate the difference between the original estimate of quantities therefor and the amount that should be paid by reason of the modification and change and the difference shall be deducted from the original estimate of quantities therefore of said Contract and said Contractor shall be paid accordingly. The estimate of said Commissioner shall be final and conclusive upon the parties hereto and may not be challenged except in a proceeding commenced pursuant to Article 78 of the Civil Practice Law and Rules. Any changes, modifications or deductions shall in no way invalidate this Contract and said Contractor agrees that in the event of any such change or modification reducing the original, estimated quantities therefore, it will not make any claim for any profit, or loss of profit by reason thereof. Notwithstanding any dispute or disagreement arising hereunder, Contractor agrees that the Work shall not be delayed nor disrupted by reason thereof.

The County hereby covenants and agrees with the said Contractor, in consideration of the covenants and agreements herein being strictly and in all respects complied with by the said Contractor as specified, that it will well and truly pay unto the said Contractor the unit prices set forth in the Proposal for the various items included in the Contract.

All partial payments will be made in accordance with the provisions set forth in the "Information for Bidders" and especially that part thereof which relates to "Estimates and Payments".

Furthermore, all partial payments will be made on the claim voucher and verified certificate of the Commissioner, both of which shall be filed in the Office of the Commissioner of Finance of the County of Westchester. The said claim voucher shall show the value of the work completed and the verified certificate shall show the said work was done in accordance with the plans and specifications.

With the final estimate the Contractor shall furnish to the Construction Administrator a sworn statement listing all unpaid bills and liabilities incurred under this Contract up to and including the date of the estimate. Where there are any bills or liabilities in excess of moneys due under any estimate under this Contract, the Construction Administrator may withhold payment of the estimate pending a satisfactory proof of settlement or adjustment of any excess claims. No final estimate will be approved or passed for payment unless and until the Contractor furnishes satisfactory proof that all bills and liabilities incurred under the Contract are paid in full and complies with the requirements of Section 220-a of the Labor Law.

Acceptance shall be effected as follows: whenever, in the opinion of the Commissioner, the Contractor shall have completely performed the Contract on his part to be performed, the Commissioner shall so certify in writing to the Board of Acquisition and Contract of the County and file such certificate with the said Board, stating therein, in substance that the work has been duly examined by him and that the same has been fully performed and completed in accordance

with the terms of the Contract therefor, and recommending the acceptance thereof. When the Board of Acquisition and Contract by resolution duly adopts, approves and ratifies, the said acceptance shall be complete. No final payment shall be made under this Contract until such certificate of completion and recommendation of acceptance have been approved and ratified by a resolution of said Board of Acquisition and Contract.

Unless otherwise provided for in the contract documents, the Commissioner may take over, use, occupy or operate any part of the Work at any time prior to Final Acceptance upon written notification to the Contractor. The Engineer shall inspect the part of the Work to be taken over, used, occupied or operated, and will furnish the Contractor with a written statement of the Work, if any, that remains to be performed on such part. The Contractor shall not object to, nor interfere with, the Commissioner's decision to exercise the rights granted herein. In the event the Commissioner takes over, uses, occupies or operates any part of the work: (i) the Commissioner shall issue a written determination of Substantial Completion with respect to such part of the Work; and (ii) the Contractor shall be relieved of its absolute obligation to protect such part of the unfinished work in accordance with Article 20 of the General Clauses.

The Commissioner will approve a final estimate for final payment consistent with the authorization of final acceptance from the Board of Acquisition and Contract less previous payments and any and all deductions authorized to be made by the Commissioner under the Contract or law. Payment pursuant to such final estimate less any additional deductions authorized to be made by the Commissioner of Finance under the Contract or law shall constitute the final payment and shall be made by the Commissioner of Finance. If the contract is terminated prior to final acceptance the Commissioner is authorized to prepare a final payment as otherwise authorized by the Board of Acquisition and Contract subject to the above noted adjustments.

Upon the completion and acceptance of this Contract by the Board of Acquisition and Contract, as aforesaid, the Commissioner shall proceed with all reasonable diligence to ascertain from actual measurements the whole amount of work done by the Contractor, and also the value of such work under and according to the terms of this Contract, and thereupon make out in writing a final estimate therefor.

After the completion and acceptance as herein above-mentioned, the Commissioner of Public Works shall file with the Commissioner of Finance of the County of Westchester the original verified certificate, claim voucher and the certification required by Section 220-a of the Labor Law, together with a certified copy of the resolution of approval and ratification of the Board of Acquisition and Contract of the said verified certificate and claim voucher and the resolution of acceptance of completion.

IT IS FURTHER UNDERSTOOD AND AGREED by and between the parties to this Contract that the Contractor will accept the unit prices named in the proposal for all additions to or deductions from the original quantities as given in the specifications. It is agreed that the Commissioner will make estimates of the value for the work completed as provided in the specifications and the final estimate will be made accordingly.

The Contractor further agrees that if at any time before or within thirty days after the whole of the work herein agreed to be performed has been completed and accepted any person or persons claiming to have performed any labor or furnished any material towards the performance and completion of this contract shall file with the proper officials any such notice as is described in the Lien Law, or any other act of the Legislature of the State of New York, the Contractor shall cause such Lien to be discharged of record. Otherwise and in every case and until the Lien is discharge of record the County shall retain, anything herein to the contrary notwithstanding, from the moneys under its control and due or to grow due under this Contract the sum of one hundred fifty (150%) percent of the amount of such Lien, unless otherwise authorized to withhold a larger amount. The Contractor further agrees to pay the County upon demand the costs, including but not limited to attorney's fees, incurred by the County in any action(s) brought to foreclose or otherwise enforce said Lien.

The Contractor covenants and agrees to commence the work embraced in this Contract within Ten [10] calendar days after service upon him, by the Commissioner, of written notice instructing him to begin the work and shall complete the same in all respects within _____ consecutive calendar days computed from the date of such Notice to Commence.

It is further understood and agreed by the parties hereto that the time of completion is of the essence of this Contract.

It is further understood and agreed by the Contractor that before entering upon the performance of this Contract it shall have approved by the County Attorney the Bond required to be furnished by it in the sum of-----
[\$ _____] conditioned for the faithful performance of the work.

The Contractor hereby covenants and agrees to observe the plans, specifications and directions of the Commissioner in the doing of the work provided for under this Contract and to furnish the necessary materials and implements required therefore and to remove condemned material and rubbish as provided by plans and specifications and to employ a competent and sufficient force of workmen to complete the work of this improvement within the time specified. Should the Contractor at any time become insolvent, make an assignment for the benefit of creditors, abandon the Work, reduce its working force to a number which, if maintained, would be insufficient, in the sole opinion of the Commissioner, to complete the Work in accordance with the approved progress schedule; sublet, assign or otherwise dispose of this Contract other than as permitted elsewhere herein, refuse or neglect to supply a sufficiency of properly skilled workmen, or of material of the proper quantity or fail in any respect to prosecute the work with promptness and diligence, or fail in any other way in the performance of any of the agreements herein contained; all the foregoing being deemed acts of default, and such default being certified by the Commissioner, the County of Westchester, acting by the Board of Acquisition and Contract, shall be at liberty after five days written notice to the Contractor to provide any such labor or materials, use any and all sums due or to become due to the Contractor under this Contract, to pay for such labor and material, and if the Commissioner shall certify that such default is sufficient ground for such action, the County of Westchester acting by the Board of Acquisition and Contract, shall also be at liberty to terminate the employment of the Contractor for the said work and to enter upon the premises and take possession for the purpose of completing the work included under this Contract of all materials, tools and appliances thereon

and to employ any other person or persons to finish the work and provide the materials therefore. Upon the Contractor's receipt of a notice from the County the Contractor shall immediately discontinue all further operations under this Contract. In case of such termination, the Contractor shall not be entitled to receive any further payment under this Contract until the said work shall be wholly finished, at which time if the unpaid balance of the amount to be paid under this Contract shall exceed the reasonable value of the work performed and the material furnished or the total costs therefor, whichever is greater, in finishing the work, such excess shall be paid by the County of Westchester to the Contractor, but if such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the County.

The expense incurred by the County and the total costs as herein provided either for furnishing materials or for finishing the work and any damage incurred through such default shall be certified by the Commissioner whose certificate thereof shall be final and conclusive upon the parties and may not be challenged except in a proceeding commenced pursuant to Article 78 of the Civil Practice Law and Rules.

In case the County shall declare the Contractor in default as to a part of the work only, the Contractor shall immediately discontinue such part, shall continue performing the remainder of the Work in strict conformity with the terms of the Contract.

In completing the whole or any part of the Work under the provisions of this Contract, the Commissioner shall have the power to depart from or change or vary the terms and provisions of this Contract. Such departure, change or variation, even to the extent of accepting a lesser or different performance, shall not affect the conclusiveness of the Commissioner's certification of the cost of completion referred to above, nor shall it constitute a defense to an action to recover the amount by which such certificate exceeds the amount which would have been payable to the Contractor hereunder but for his default or partial default.

In addition to termination as provided for above, the County may terminate this Contract for the convenience of the County by written notice to the Contractor from the Commissioner. In such event and upon receipt of such notice the Contractor shall stop work on the date specified in the notice; take such actions as may be necessary to protect and preserve the County's materials and property; cancel all cancelable orders for material and equipment; assign to the County and deliver to the jobsite or any other location designated by the Commissioner any non-cancelable orders for material and equipment that is not capable of use except in the performance of this Contract and which has been specifically fabricated for the sole purpose of this Contract and not incorporated in the Work; and take no action that will increase the amounts payable by the County under this Contract.

In the event the contract is cancelled for the convenience of the County the following provisions shall apply:

- (a) For Work completed prior to the notice of termination, the Contractor shall be paid the fair and reasonable value of its work determined by the pro rata portion of the lump sum bid amount based upon the percent completion of the Work as of the date of termination as determined by the Commissioner, plus work completed pursuant to approved change orders, less amounts

previously paid. For purposes of determining the pro rata portion of the lump sum bid amount to which the Contractor is entitled, the Contractor's approved bid breakdown pursuant to Article 21 of the Information for Bidders shall be considered but shall not be dispositive as to the fair and reasonable value.

- (b) For non-cancelable material and equipment that is not capable of use except in the performance of this Contract and which has been specifically fabricated for the sole purpose of this Contract, but not yet incorporated in the Work, the Contractor shall be paid the fair and reasonable value thereof as determined by the Commissioner, but not more than the Contractor's cost for such material and equipment, plus an additional sum of two (2%) percent of such fair and reasonable value.
- (c) In the event the County terminates a lump sum Contract for convenience within thirty (30) days after the Contractor has received the Notice of Award from the County, the Contractor shall be paid one (1%) percent of the difference between the total lump sum bid amount and the total of all payments made prior to the notice of termination plus all payments allowed pursuant to (a) and (b).
- (d) On all unit price Contracts, or on unit price items in a Contract, the County will pay the Contractor the sum of (e) and (f) below, less all payments previously made pursuant to this Contract:
- (e) For all completed units, the unit price stated in the Contract, and
- (f) For units that have been ordered but are only partially completed, the Contractor will be paid (i) a pro rata portion of the unit price as stated in the Contract based upon the percent completion of the unit as determined by the Commissioner and (ii) for non-cancelable material and equipment, payment will be made pursuant to (b), above.
- (g) The Commissioner's determination(s) hereunder shall be final, binding and conclusive and subject to review only pursuant to Article 78 of the New York Civil Practice Law and Rules.
- (h) The County shall not be liable to the Contractor for any payment or claim if the termination for convenience results in a reduction of thirty (30%) percent or less of the original contract price as bid.

On all Contracts or items in a Contract where time and material records are specified as the basis for payment of the Work, the Contractor shall be paid in accordance with Article 29 of the General Clauses, less all payments previously made pursuant to this Contract.

In no event shall any payments made pursuant to a termination for convenience exceed the Contract price for such items, either individually or collectively.

All payments made pursuant to a termination for convenience shall be in the nature of liquidated damages and shall be accepted by the Contractor in full satisfaction of all claims against the County.

The County may deduct or set off against any sums due and payable arising from a termination for convenience, any claims it may have against the Contractor.

In the event the County terminates the Contractor for default and it is subsequently determined that the Contractor was not in default, said termination shall automatically be converted for all purposes into a termination for convenience.

It is further understood and agreed between the parties hereto that no certificate given or payment made under this Contract, except the final certificate or final payment shall be conclusive evidence of the performance of this Contract either wholly or in part and that no payment shall be construed to be an acceptance of defective work or improper materials. If the Contractor shall fail to replace any defective work or materials, the County may cause such defective materials to be removed and defective work to be replaced and the expense thereof shall be deducted from the amount to be paid the Contractor.

Anything to the contrary in the preceding paragraph notwithstanding, the Contractor is responsible for the repair of defects in materials and workmanship for a period of one year from the date of final acceptance of the work by the Board of Acquisition and Contract, unless a longer term is specified in the specifications.

The Contractor further agrees not to assign, transfer, convey, sublet or otherwise dispose of this Contract, or its right, title or interest in or to the same, or any part hereof without the previous consent in writing of the Board of Acquisition and Contract of the County. Before a Subcontractor shall proceed with any work, the Commissioner must first recommend and the Board of Acquisition and Contract must approve the use of the Subcontractor on this Contract. If a Subcontractor is not approved it may not work on this Contract. The Contractor specifically waives any claim due to the failure or refusal of the Commissioner or the Board of Acquisition and Contract to approve said Subcontractor.

The Contractor agrees to hold himself responsible for any claims made against the County for any infringement of patents by the use of patented articles in the construction and completion of the work or any process connected with the work agreed to be performed under this Contract or of any material used upon the said work, and shall indemnify and save harmless the County for the costs, expenses and damages which the County may be obligated to pay by reason of any infringement of patents used in the construction and completion of the work.

The parties hereto agree that no laborer, workman or mechanic in the employ of the Contractor, Subcontractor or other person doing or contracting to do the whole or part of the work contemplated by the Contract shall be permitted or required to work more than eight hours in any one calendar day or more than five days in any one week except in cases of extraordinary emergency including fire, flood or danger to life or property. No such person shall be so employed more than eight hours in any day or more than five days in any one week except in such emergency. Time lost in any week because of inclement weather by employees engaged in

the construction, reconstruction and maintenance of highways outside of the limits of cities and villages may be made up during that week and/or the succeeding three weeks.

The Contractor further agrees to erect and maintain during construction all necessary guards, rails and signals to prevent accidents to persons, vehicles or to the adjoining property and also agrees to use all necessary precautions in blasting and that he will indemnify and save the County of Westchester harmless from all suits and actions of any kind and nature whatsoever from or on account of the construction of said work.

It is further understood and agreed by the parties hereto that should any dispute arise respecting the true construction, interpretation or meaning of the Contract plans, specifications or conditions herein, or the measurements for the payment thereunder, same shall be referred to and decided by the said Commissioner and his decision thereon shall be final and conclusive upon the parties thereto and may not be challenged except in a proceeding commenced pursuant to Article 78 of the Civil Practice Law and Rules. This provision shall also apply to the true value of and duly authorized extra work or any work permitted by agreement in case any work shall be ordered performed, or any work called for shall be so omitted under and upon the direction of said Commissioner.

The Contractor by the submitting of bids and execution of this Contract hereby covenants and agrees that he has examined the plans, specifications and the site work, as to local conditions, difficulties and accuracy of approximate estimate of quantities and does hereby further covenant and agree that he will not make any claim for damages by reason of any such local conditions, difficulties or variation of approximate estimate of quantities.

The Contractor represents and warrants to the County with the knowledge and expectation that this warranty will be relied upon by the County that it is not now participating and has not at any time participated, either directly or through any substantially owned or affiliated person, firm, partnership or corporation, in an international boycott in violation of the provisions of United States Export Administration Act of 1969, 50 USC 2401 et seq. or the regulations promulgated thereunder.

The Contractor further warrants and represents that it is financially solvent, and sufficiently experienced and competent to perform the work and that the facts provided by it to the County in its bid and supporting documents, and contract documents are true and correct in all respects.

This Contract shall become void and any rights of the Contractor hereunder shall be forfeited if, subsequent to the execution hereof, the Contractor is convicted of a violation of the provision of the United States Export Administration Act of 1969, 50 USC 2401 et seq. as amended or has been found upon the final determination of the United States Commerce Department or any other appropriate agency of the United States or the State of New York to have violated such act or regulations.

If the Contractor, any officer, director, or any party holding a controlling interest (defined as five (5%) percent or more, or in the case of a corporation, any stockholder owning five (5%) percent or more of the outstanding shares) is convicted of a crime (excluding Class B and

Unclassified Misdemeanors as defined under the New York State Penal Law and their equivalent in any city, state or under Federal law related to the type of services or activities which are the subject matter of this Contract) or if a related or affiliated company, partnership or corporation is convicted of a crime (excluding Class B and Unclassified Misdemeanors as defined above) after this Contract is fully executed, the County shall have the right to terminate this Agreement immediately and without penalty. An "affiliated company" as used herein means any affiliate which is a partnership, corporation, proprietorship, association or other entity (i) in which a 50% or greater ownership interest (as defined below) is directly or indirectly held by the Contractor or any of its management personnel (as defined below) or directors, (ii) which directly or indirectly holds 50% or more of the ownership interest in the Contractor, (iii) in which an aggregate 20% or greater ownership interest is directly or indirectly held by one or more shareholders (or partners or proprietors, in the case of a partnership or proprietorship) which or who in the aggregate hold a 20% or greater ownership interest in the Contractor, or (iv) which, whether by Contract or otherwise, directly or indirectly controls, is controlled by or is under common control with the Contractor. An "ownership interest" means the ownership, whether legally or beneficially, of the stock of or assets employed by a corporation, of a partnership interest in or assets employed by a partnership or of a similar interest in or assets employed by any other entity. "Management personnel" means executive officers and all other persons, whether or not officers or employees, who perform policy-making functions similar to those of executive officers.

The Contractor represents that at the time of execution of this Contract, no individual or entity, as described above, has been convicted of a crime during the five (5) year period preceding the execution of this Contract.

The parties hereto recognize that it is the goal of Westchester County to use its best efforts to encourage, promote and increase participation of business enterprises owned and controlled by persons of color or women (MBE/WBE) in contracts or projects funded by all Departments of the County and to effectively and efficiently monitor such participation. Therefore, the Contractor agrees to complete the MBE/WBE Questionnaire, which is attached hereto as Schedule "A," in furtherance of this goal and in accordance with Local Law No. 27-1997.

It is recognized and understood by the parties that this Contract is subject to appropriation by the Westchester County Board of Legislators. The County shall have no liability under this Contract beyond the funds, if any, that are appropriated and available for payment of the amounts due under this Contract. Notwithstanding the foregoing, the County will do all things lawfully within its power to obtain, maintain and properly request and pursue funds from which payments under this Contract may be made.

The parties hereto for themselves, their legal representatives, successors and assigns, expressly agree that any legal action or proceeding that may arise out of or relating to this Contract shall be brought and maintained only in the courts of the State of New York ("New York State Court") located in the County of Westchester. With respect to any action between the County and Contractor in New York State Court, the Contractor hereby expressly waives and relinquishes any rights it may otherwise have (i) to move to dismiss on grounds of *forum non*

conveniens; (ii) to remove to Federal Court; and (iii) to move for a change of venue to a New York State Court outside of Westchester County.

This Contract and its terms, covenants, obligations, conditions and provisions shall be binding upon all the parties hereto, their legal representatives, successors and assigns.

SAMPLE

This Contract shall not be enforceable until it is signed by all parties and approved by the Office of the County Attorney.

IN WITNESS WHEREOF, the parties hereto have executed this agreement, THE COUNTY OF WESTCHESTER pursuant to law by:

_____ its **Commissioner**

and the CONTRACTOR:

By: _____ its _____
(Type or Print Name) (Title)

THE COUNTY OF WESTCHESTER:

By: _____
Commissioner

CONTRACTOR:

By: _____
(Signature)

ATTEST:

(SEAL)

By: _____
(Signature)

Recommended:

Deputy Commissioner of Public Works

Approved as to form and manner of execution
this ____ day of _____, 200__

County Attorney

CONTRACTOR'S ACKNOWLEDGMENT
(If Corporation)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this ____ day of _____, 200__, before me personally came _____ to me known, and known to me to be the _____ of _____, the Corporation described in and which executed the within instrument, who being by me duly sworn did depose and say that the said _____ resides at _____ and that he/she is the _____ of said Corporation and that he/she signed his/her name thereto by order of the Board of Directors of said Corporation and, if operating under any trade name, that the certificate required by the New York State General Business Law Section 130 has been filed with the Secretary of State of the State of New York.

Notary Public

CONTRACTOR'S ACKNOWLEDGMENT
(If Individual)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this ____ day of _____, 200__, before me personally came _____ to me known, and known to me to be the same person described in and who executed the within instrument and duly acknowledged to me that he/she executed the same for the purpose herein mentioned and, if operating under any trade name, that the certificate required by the New York State General Business Law Section 130 has been filed with the County Clerk of Westchester County.

Notary Public

CONTRACTOR'S ACKNOWLEDGMENT
(If Co-Partnership)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this ____ day of _____, 200__, before me personally came _____ to me known, and known to me to be a member of the firm of _____ and the person described in, and who executed the within instrument in behalf of said firm, and he/she acknowledged to me that he/she executed the same in behalf of, and as the act of said firm for the purposes herein mentioned and, if operating under any trade name, that the certificate required by the New York State General Business Law Section 130 has been filed with the County Clerk of Westchester County.

Notary Public

CERTIFICATE OF AUTHORITY

I, _____
(Officer other than officer signing contract)

certify that I am _____ of
(Title)

the _____
(Name of Corporation)

organized and in good standing under the _____
(Law under which organized)

named in the foregoing agreement; that _____
(Person executing agreement)

who signed said agreement on behalf of the Contractor was, at the time of execution the
_____ of the Corporation; that said agreement was duly
(Title of such person)

signed for and on behalf of said Corporation by authority of its Board of Directors, thereunto
duly authorized and is in full force and effect at the date hereof.

(Signature)

(SEAL)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this ____ day of _____, 200__, before me personally came
_____ to me known, and known to me to be the
_____ of _____,
the Corporation described in and which executed the above certificate, who being by me duly
sworn did depose and say that the said _____ resides at
_____ and that he/she is
_____ of said Corporation and knows the Corporate Seal of the said
Corporation; that the seal affixed to the above certificate is such Corporate Seal and was so
affixed by order of the Board of Directors of said Corporation, and that he/she signed his/her
name thereto by like order.

Notary Public

CORPORATE ACKNOWLEDGEMENT
(Sole Officer)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this ____ day of _____, 200__, before me personally came
_____ to me known, and known to me to be the
(Name)
_____ of _____,
(Title) *(Name of Corporation)*
the Corporation described in and which executed the within instrument, who being by me duly
sworn did depose and say that he/she signed the within instrument, on behalf of said
Corporation, in his/her capacity as _____ and Sole Officer and
(Title)
director of said Corporation and that he/she owns all the issued and outstanding capital stock of
said Corporation and knows the Corporate Seal of the said Corporation; and, if operating under
any trade name, that the certificate required by New York State General Business Law Section
130 has been filed with the Secretary of State of the State of New York.

Notary Public

PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that we

(hereinafter called the "Principal"), and the _____

_____ a Corporation created and existing under the laws of the State of _____

and having its principal office at _____

in the City of _____ (hereinafter called the "Surety"), are held and firmly bound unto The County of Westchester (hereinafter called the "Obligee") in the penal sum of-----**DOLLARS**-----**AND**-----/100-----

--[\$]

lawful money of the United States of America, for the payment of which, well and truly to be made, the said Principal binds itself, (himself, themselves) and its (his, their) successors and assigns, and the said Surety binds itself and its successors and assigns, all jointly and severally, firmly by these presents. Said penal sum shall apply separately and independently, in its total amount, to the payment provision and the performance provision of this Bond shall not reduce or limit the right of the Obligee to recover under the other said provision.

Signed, sealed and dated this _____ day of _____, 200__.

WHEREAS, said Principal has entered into a certain written contract with said Obligee, dated this _____ day of _____, 200__, (hereinafter called the "Contract")

For ----**CONTRACT #** _____ a copy of which Contract is hereto annexed and hereby made a part of this bond as if herein set forth in full.

NOW THEREFORE, THE CONDITIONS OF THE ABOVE OBLIGATIONS ARE SUCH THAT, if the said Principal, and its (his, their) successors or assigns, or any or either of them shall,

(1) well and truly and in good, sufficient and workmanlike manner, perform or cause to be performed such Contract, and any amendment or extension of or addition thereto, and each and every of the covenants, promises, agreements and provisions therein stipulated and contained to be performed by said Principal, and complete the same within the period therein mentioned, and in each and every respect, comply with the conditions therein mentioned to be complied with by said Principal, and fully indemnify and save harmless the Obligee from all costs and damages which it may suffer by reason of failure so to do and fully reimburse and repay the Obligee all outlay and expense which it may incur in making good any such default, and

(2) also pay or cause to be paid the wages and compensation for labor performed and services rendered of all persons engaged in the prosecution of the work provided for therein, whether such persons by agents, servants or employees of the Principal, and of its (his, their) successors or assigns, or any Subcontractor or of any assignee thereof, including all persons so engaged who perform the work of laborers or of mechanics regardless of any contractual relationship between the Principal, or its (his, their) successors or assigns, or any Subcontractor or any designee thereof, and such laborers or mechanics, but not including office employees not regularly stationed at the site of the work, and further, shall pay or cause to be paid all lawful claims of Subcontractors and of materialmen and other third persons out of or in connection with said Contract and the work, labor, services, supplies and material furnished in and about the performance and completion thereof, then these obligations shall be null and void, otherwise they shall remain in full force and effect.

PROVIDED, however, that this bond is subject to the following additional conditions and limitations:

- (a) All persons who have performed labor or rendered services, as aforesaid, all Subcontractors, and all persons, firms, corporations, including materialmen and third persons, as aforesaid, furnishing work, labor, services, supplies and material under or in connection with said Contract or in or about the performance and completion thereof, shall have a direct right of action (subject to the prior right of the Obligee under any claim which it may assert against the Principal or its (his, their) successors and assigns, and/or the Surety and its successors and assigns) against the Principal and its (his, their) successors and assigns on this bond, which right of action shall be asserted in proceedings instituted in the State in which such work, labor, services, supplies or material was performed, rendered or furnished or where work, labor, services, supplies or material has been performed, rendered or furnished, as aforesaid, in more than one State, than in any such State. Insofar as permitted by the laws of such State, said right of action shall be asserted in a proceeding instituted in the name of Obligee to the use and benefit of the person, firm or corporation instituting such action and of all other persons, firms and corporations having claims hereunder, and any other person, firm or corporation having a claim hereunder shall have the

right to be made a party to such proceedings (but not later than twelve months after the performance of said Contract and final settlement thereof) and to have such claim adjudicated in such action and judgment rendered thereon. Prior to the institution of such a proceeding by a person, firm or corporation in the name of the Obligee, as aforesaid, such person, firm or corporation shall furnish the Obligee with a Bond of Indemnity for costs, which Bond shall be in an amount satisfactory to the Obligee.

- (b) The Surety or its successors or assigns shall not be liable hereunder for any damages or compensation recoverable under any worker's compensation or employer's liability statute.
- (c) In no event shall the Surety or its successors or assigns be liable under either the foregoing clause (1) or the foregoing clause (2) for a greater sum than the penalty of this Bond provided; however, that said penalty is separately applicable, in its total amount to each of the foregoing clauses (1) and (2), or subject to any suit, action or proceeding hereon that is instituted by any person, firm or corporation under the provisions of the above section (a) later than twelve months after the complete performance of said Contract and final settlement thereof.

The Principal, for itself (himself, themselves) and its (his, their) successors and assigns, and the Surety, for itself and its successors and assigns, do hereby expressly waive any objections that might be interposed as to the right of the Obligee to require a Bond containing the foregoing provisions, and they do hereby further expressly waive any defense which they or either of them might interpose to an action brought hereon by any person, firm or corporation, including Subcontractors, materialmen, and third persons, for work, labor, services, supplies or material performed, rendered or furnished as aforesaid, upon the ground that there is no law authorizing the said Obligee to require the foregoing provision to be placed in this Bond.

And Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligations of said Surety and of its successors and assigns and this Bond shall in no way be impaired or affected by an extension of time, modification, omission, addition or change in or to the said Contract or the work to be performed thereunder, or by any payment thereunder, before the time required therein, or by any waiver of any provision thereof, or by an assignment, subletting or other transfer thereof, or of any part thereof, or of any work to be performed, or of any moneys due or to become due thereunder; and the said Surety, for itself and its successors and assigns, does hereby waive notice of any and all of such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers, and hereby stipulates and agrees that any and all things done and omitted to be done by and in relation to (executors, administrators), successors, assigns, Subcontractors, and other transferees, shall have the same effect as to said Surety and its successors and assigns, as though done or omitted to be done by and in relation to said Principal.

And Surety, for value received, hereby stipulates and agrees, if requested to do so by Obligee, to fully perform and complete the work to be performed under the Contract, pursuant to the terms, conditions and covenants thereof, if for any cause, the Principal fails or neglects to so

fully perform and complete such Work. The Surety further agrees to commence such Work of Completion within twenty-five (25) calendar days after written notice thereof from the Obligee, and to complete such Work within twenty-five (25) calendar days from the expiration of the time allowed the Principal in the Contract for the completion of such Work.

WITNESSETH our hands and seals this ____ day of _____, 200__.

PRINCIPAL:

By: _____
(Signature)

(SEAL)

ATTEST:

(Surety)

By: _____
(Signature)

(SEAL)

ATTEST:

If the Contractor (Principal) is a partnership, the Bond should be signed by each of the individuals who are partners.

If the Contractor (Principal) is a Corporation, the Bond should be signed in its correct corporate name by a duly authorized officer, agent, or attorney-in-fact.

There should be executed an appropriate number of counterparts of the Bond corresponding to the number of counterparts of the Contract.

Each executed Bond should be accompanied by:

- (a) appropriate acknowledgments of the respective parties;
- (b) appropriate duly certified copy of Power of Attorney or other Certificate of Authority where Bond is executed by agent, officer or other representative of Principal or Surety;
- (c) a duly certified extract from By-laws or resolutions of Surety under which Power of Attorney or other Certificate of Authority of its agent, officer or representative was issued, and
- (d) duly certified copy of latest published financial statement of assets and liabilities of Surety.

CONTRACTOR'S ACKNOWLEDGMENT
(If Corporation)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this ____ day of _____, 200__, before me personally came _____ to me known, and known to me to be the _____ of _____, the Corporation described in and which executed the within instrument, who being by me duly sworn did depose and say that the said _____ resides at _____ and that he/she is the _____ of said Corporation and knows the Corporate Seal of the said Corporation; that the seal affixed to the within instrument is such Corporate Seal and that it was so affixed by order of the Board of Directors of said Corporation and that he/she signed his/her name thereto by like order.

Notary Public

CONTRACTOR'S ACKNOWLEDGMENT
(If Individual)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this ____ day of _____, 200__, before me personally came _____ to me known, and known to me to be the same person described in and who executed the within instrument and he/she duly acknowledged to me that he/she executed the same for the purpose herein mentioned.

Notary Public

CONTRACTOR'S ACKNOWLEDGMENT
(If Co-Partnership)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this ____ day of _____, 200__, before me personally came _____ to me known, and known to me to be a member of the firm of _____ and the person described in, and who executed the within instrument in behalf of said firm, and acknowledged to me that he/she executed the same in behalf of, and as the act of said firm for the purposes herein mentioned.

Notary Public

BOND

BOND

ACKNOWLEDGMENT BY SURETY COMPANY
(Signed by One Authorized Person)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this _____ day of _____, 200__, before me personally came

(Name)
_____ of _____,
(Title) (Name of Corporation)
the Corporation described in and which executed the within instrument, who being by me duly
sworn did depose and say that he/she resides at _____
_____ and that he/she is the _____ of said Corporation
(Title)
and knows the Corporate Seal of the said Corporation; that the seal affixed to the within
instrument is such Corporate Seal and so affixed by order of the Board of Directors of said
Corporation and that he/she signed his/her name thereto by like order; and that the said
Corporation has received from the Superintendent of Insurance of the State of New York a
Certificate of Solvency, and of its sufficiency as Surety or Guarantor, pursuant to Section 327 of
the Insurance Law of the State of New York as amended, and that such Certificate has not been
revoked.

Notary Public



SCHEDULE OF HOURLY RATES
AND SUPPLEMENTS

DEPARTMENT OF PUBLIC WORKS

Division of Engineering



Kathy Hochul, Governor

Roberta Reardon, Commissioner

Westchester County DPWT

Yolanda Spraggins, Secretary II
148 Martine Avenue, Rm 518
White Plains NY 10601

Schedule Year 2023 through 2024
Date Requested 12/04/2023
PRC# 2023014100

Location Low Rise Building
Project ID# 20-502
Project Type Low Rise Building Renovations and HVAC Improvements including various general contractor work, as well as elevator upgrades and lighting.

PREVAILING WAGE SCHEDULE FOR ARTICLE 8 PUBLIC WORK PROJECT

Attached is the current schedule(s) of the prevailing wage rates and prevailing hourly supplements for the project referenced above. A unique Prevailing Wage Case Number (PRC#) has been assigned to the schedule(s) for your project.

The schedule is effective from July 2023 through June 2024. All updates, corrections, posted on the 1st business day of each month, and future copies of the annual determination are available on the Department's website www.labor.ny.gov. Updated PDF copies of your schedule can be accessed by entering your assigned PRC# at the proper location on the website.

It is the responsibility of the contracting agency or its agent to annex and make part, the attached schedule, to the specifications for this project, when it is advertised for bids and /or to forward said schedules to the successful bidder(s), immediately upon receipt, in order to insure the proper payment of wages.

Please refer to the "General Provisions of Laws Covering Workers on Public Work Contracts" provided with this schedule, for the specific details relating to other responsibilities of the Department of Jurisdiction.

Upon completion or cancellation of this project, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

NOTICE OF COMPLETION / CANCELLATION OF PROJECT

Date Completed: _____ Date Cancelled: _____

Name & Title of Representative: _____

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12226

General Provisions of Laws Covering Workers on Article 8 Public Work Contracts

Introduction

The Labor Law requires public work contractors and subcontractors to pay laborers, workers, or mechanics employed in the performance of a public work contract not less than the prevailing rate of wage and supplements (fringe benefits) in the locality where the work is performed.

Responsibilities of the Department of Jurisdiction

A Department of Jurisdiction (Contracting Agency) includes a state department, agency, board or commission; a county, city, town or village; a school district, board of education or board of cooperative educational services; a sewer, water, fire, improvement and other district corporation; a public benefit corporation; and a public authority awarding a public work contract.

The Department of Jurisdiction (Contracting Agency) awarding a public work contract MUST obtain a Prevailing Rate Schedule listing the hourly rates of wages and supplements due the workers to be employed on a public work project. This schedule may be obtained by completing and forwarding a "Request for wage and Supplement Information" form (PW 39) to the Bureau of Public Work. The Prevailing Rate Schedule MUST be included in the specifications for the contract to be awarded and is deemed part of the public work contract.

Upon the awarding of the contract, the law requires that the Department of Jurisdiction (Contracting Agency) furnish the following information to the Bureau: the name and address of the contractor, the date the contract was let and the approximate dollar value of the contract. To facilitate compliance with this provision of the Labor Law, a copy of the Department's "Notice of Contract Award" form (PW 16) is provided with the original Prevailing Rate Schedule.

The Department of Jurisdiction (Contracting Agency) is required to notify the Bureau of the completion or cancellation of any public work project. The Department's PW 200 form is provided for that purpose.

Both the PW 16 and PW 200 forms are available for completion [online](#).

Hours

No laborer, worker, or mechanic in the employ of a contractor or subcontractor engaged in the performance of any public work project shall be permitted to work more than eight hours in any day or more than five days in any week, except in cases of extraordinary emergency. The contractor and the Department of Jurisdiction (Contracting Agency) may apply to the Bureau of Public Work for a dispensation permitting workers to work additional hours or days per week on a particular public work project.

Wages and Supplements

The wages and supplements to be paid and/or provided to laborers, workers, and mechanics employed on a public work project shall be not less than those listed in the current Prevailing Rate Schedule for the locality where the work is performed. If a prime contractor on a public work project has not been provided with a Prevailing Rate Schedule, the contractor must notify the Department of Jurisdiction (Contracting Agency) who in turn must request an original Prevailing Rate Schedule from the Bureau of Public Work. Requests may be submitted by: mail to NYSDOL, Bureau of Public Work, State Office Bldg. Campus, Bldg. 12, Rm. 130, Albany, NY 12226; Fax to Bureau of Public Work (518) 485-1870; or electronically at the NYSDOL website www.labor.ny.gov.

Upon receiving the original schedule, the Department of Jurisdiction (Contracting Agency) is REQUIRED to provide complete copies to all prime contractors who in turn MUST, by law, provide copies of all applicable county schedules to each subcontractor and obtain from each subcontractor, an affidavit certifying such schedules were received. If the original schedule expired, the contractor may obtain a copy of the new annual determination from the NYSDOL website www.labor.ny.gov.

The Commissioner of Labor makes an annual determination of the prevailing rates. This determination is in effect from July 1st through June 30th of the following year. The annual determination is available on the NYSDOL website www.labor.ny.gov.

Payrolls and Payroll Records

Every contractor and subcontractor MUST keep original payrolls or transcripts subscribed and affirmed as true under penalty of perjury. As per Article 6 of the Labor law, contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records. At a minimum, payrolls must show the following information for each person employed on a public work project: Name, Address, Last 4 Digits of Social Security Number, Classification(s) in which the worker was employed, Hourly wage rate(s) paid, Supplements paid or provided, and Daily and weekly number of hours worked in each classification.

The filing of payrolls to the Department of Jurisdiction is a condition of payment. Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury. The Department of Jurisdiction (Contracting Agency) shall collect, review for facial validity, and maintain such payrolls.

In addition, the Commissioner of Labor may require contractors to furnish, with ten (10) days of a request, payroll records sworn to as their validity and accuracy for public work and private work. Payroll records include, but are not limited to time cards, work description sheets, proof that supplements were provided, cancelled payroll checks and payrolls. Failure to provide the requested information within the allotted ten (10) days will result in the withholding of up to 25% of the contract, not to exceed \$100,000.00. If the contractor or subcontractor does not maintain a place of business in New York State and the amount of the contract exceeds \$25,000.00, payroll records and certifications must be kept on the project worksite.

The prime contractor is responsible for any underpayments of prevailing wages or supplements by any subcontractor.

All contractors or their subcontractors shall provide to their subcontractors a copy of the Prevailing Rate Schedule specified in the public work contract as well as any subsequently issued schedules. A failure to provide these schedules by a contractor or subcontractor is a violation of Article 8, Section 220-a of the Labor Law.

All subcontractors engaged by a public work project contractor or its subcontractor, upon receipt of the original schedule and any subsequently issued schedules, shall provide to such contractor a verified statement attesting that the subcontractor has received the Prevailing Rate Schedule and will pay or provide the applicable rates of wages and supplements specified therein. (See NYS Labor Laws, Article 8 . Section 220-a).

Determination of Prevailing Wage and Supplement Rate Updates Applicable to All Counties

The wages and supplements contained in the annual determination become effective July 1st whether or not the new determination has been received by a given contractor. Care should be taken to review the rates for obvious errors. Any corrections should be brought to the Department's attention immediately. It is the responsibility of the public work contractor to use the proper rates. If there is a question on the proper classification to be used, please call the district office located nearest the project. Any errors in the annual determination will be corrected and posted to the NYS DOL website on the first business day of each month. Contractors are responsible for paying these updated rates as well, retroactive to July 1st.

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. To the extent possible, the Department posts rates in its possession that cover periods of time beyond the July 1st to June 30th time frame covered by a particular annual determination. Rates that extend beyond that instant time period are informational ONLY and may be updated in future annual determinations that actually cover the then appropriate July 1st to June 30th time period.

Withholding of Payments

When a complaint is filed with the Commissioner of Labor alleging the failure of a contractor or subcontractor to pay or provide the prevailing wages or supplements, or when the Commissioner of Labor believes that unpaid wages or supplements may be due, payments on the public work contract shall be withheld from the prime contractor in a sufficient amount to satisfy the alleged unpaid wages and supplements, including interest and civil penalty, pending a final determination.

When the Bureau of Public Work finds that a contractor or subcontractor on a public work project failed to pay or provide the requisite prevailing wages or supplements, the Bureau is authorized by Sections 220-b and 235.2 of the Labor Law to so notify the financial officer of the Department of Jurisdiction (Contracting Agency) that awarded the public work contract. Such officer MUST then withhold or cause to be withheld from any payment due the prime contractor on account of such contract the amount indicated by the Bureau as sufficient to satisfy the unpaid wages and supplements, including interest and any civil penalty that may be assessed by the Commissioner of Labor. The withholding continues until there is a final determination of the underpayment by the Commissioner of Labor or by the court in the event a legal proceeding is instituted for review of the determination of the Commissioner of Labor.

The Department of Jurisdiction (Contracting Agency) shall comply with this order of the Commissioner of Labor or of the court with respect to the release of the funds so withheld.

Summary of Notice Posting Requirements

The current Prevailing Rate Schedule must be posted in a prominent and accessible place on the site of the public work project. The prevailing wage schedule must be encased in, or constructed of, materials capable of withstanding adverse weather conditions and be titled "PREVAILING RATE OF WAGES" in letters no smaller than two (2) inches by two (2) inches.

The "[Public Work Project](#)" notice must be posted at the beginning of the performance of every public work contract, on each job site.

Every employer providing workers. compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers. Compensation Board in a conspicuous place on the jobsite.

Every employer subject to the NYS Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers, notices furnished by the State Division of Human Rights.

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the NYS Department of Labor.

Apprentices

Employees cannot be paid apprentice rates unless they are individually registered in a program registered with the NYS Commissioner of Labor. The allowable ratio of apprentices to journeyworkers in any craft classification can be no greater than the statewide building trade ratios promulgated by the Department of Labor and included with the Prevailing Rate Schedule. An employee listed on a payroll as an apprentice who is not registered as above or is performing work outside the classification of work for which the apprentice is indentured, must be paid the prevailing journeyworker's wage rate for the classification of work the employee is actually performing.

NYSDOL Labor Law, Article 8, Section 220-3, require that only apprentices individually registered with the NYS Department of Labor may be paid apprenticeship rates on a public work project. No other Federal or State Agency of office registers apprentices in New York State.

Persons wishing to verify the apprentice registration of any person must do so in writing by mail, to the NYSDOL Office of Employability Development / Apprenticeship Training, State Office Bldg. Campus, Bldg. 12, Albany, NY 12226 or by Fax to NYSDOL Apprenticeship Training (518) 457-7154. All requests for verification must include the name and social security number of the person for whom the information is requested.

The only conclusive proof of individual apprentice registration is written verification from the NYSDOL Apprenticeship Training Albany Central office. Neither Federal nor State Apprenticeship Training offices outside of Albany can provide conclusive registration information.

It should be noted that the existence of a registered apprenticeship program is not conclusive proof that any person is registered in that program. Furthermore, the existence or possession of wallet cards, identification cards, or copies of state forms is not conclusive proof of the registration of any person as an apprentice.

Interest and Penalties

In the event that an underpayment of wages and/or supplements is found:

- Interest shall be assessed at the rate then in effect as prescribed by the Superintendent of Banks pursuant to section 14-a of the Banking Law, per annum from the date of underpayment to the date restitution is made.
- A Civil Penalty may also be assessed, not to exceed 25% of the total of wages, supplements, and interest due.

Debarment

Any contractor or subcontractor and/or its successor shall be ineligible to submit a bid on or be awarded any public work contract or subcontract with any state, municipal corporation or public body for a period of five (5) years when:

- Two (2) willful determinations have been rendered against that contractor or subcontractor and/or its successor within any consecutive six (6) year period.
- There is any willful determination that involves the falsification of payroll records or the kickback of wages or supplements.

Criminal Sanctions

Willful violations of the Prevailing Wage Law (Article 8 of the Labor Law) may be a felony punishable by fine or imprisonment of up to 15 years, or both.

Discrimination

No employee or applicant for employment may be discriminated against on account of age, race, creed, color, national origin, sex, disability or marital status.

No contractor, subcontractor nor any person acting on its behalf, shall by reason of race, creed, color, disability, sex or national origin discriminate against any citizen of the State of New York who is qualified and available to perform the work to which the employment relates (NYS Labor Law, Article 8, Section 220-e(a)).

No contractor, subcontractor, nor any person acting on its behalf, shall in any manner, discriminate against or intimidate any employee on account of race, creed, color, disability, sex, or national origin (NYS Labor Law, Article 8, Section 220-e(b)).

The Human Rights Law also prohibits discrimination in employment because of age, marital status, or religion.

There may be deducted from the amount payable to the contractor under the contract a penalty of \$50.00 for each calendar day during which such person was discriminated against or intimidated in violation of the provision of the contract (NYS Labor Law, Article 8, Section 220-e(c)).

The contract may be cancelled or terminated by the State or municipality. All monies due or to become due thereunder may be forfeited for a second or any subsequent violation of the terms or conditions of the anti-discrimination sections of the contract (NYS Labor Law, Article 8, Section 220-e(d)).

Every employer subject to the New York State Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers notices furnished by the State Division of Human Rights.

Workers' Compensation

In accordance with Section 142 of the State Finance Law, the contractor shall maintain coverage during the life of the contract for the benefit of such employees as required by the provisions of the New York State Workers' Compensation Law.

A contractor who is awarded a public work contract must provide proof of workers' compensation coverage prior to being allowed to begin work.

The insurance policy must be issued by a company authorized to provide workers' compensation coverage in New York State. Proof of coverage must be on form C-105.2 (Certificate of Workers' Compensation Insurance) and must name this agency as a certificate holder.

If New York State coverage is added to an existing out-of-state policy, it can only be added to a policy from a company authorized to write workers' compensation coverage in this state. The coverage must be listed under item 3A of the information page.

The contractor must maintain proof that subcontractors doing work covered under this contract secured and maintained a workers' compensation policy for all employees working in New York State.

Every employer providing worker's compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers' Compensation Board in a conspicuous place on the jobsite.

Unemployment Insurance

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the New York State Department of Labor.



Kathy Hochul, Governor

Roberta Reardon, Commissioner

Westchester County DPWT

Yolanda Spraggins, Secretary II
148 Martine Avenue, Rm 518
White Plains NY 10601

Schedule Year 2023 through 2024
Date Requested 12/04/2023
PRC# 2023014100

Location Low Rise Building
Project ID# 20-502
Project Type Low Rise Building Renovations and HVAC Improvements including various general contractor work, as well as elevator upgrades and lighting.

Notice of Contract Award

New York State Labor Law, Article 8, Section 220.3a requires that certain information regarding the awarding of public work contracts, be furnished to the Commissioner of Labor. One "Notice of Contract Award" (PW 16, which may be photocopied), **MUST** be completed for **EACH** prime contractor on the above referenced project.

Upon notifying the successful bidder(s) of this contract, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

Contractor Information

All information must be supplied

Federal Employer Identification Number: _____		
Name: _____		
Address: _____ _____		
City: _____	State: _____	Zip: _____
Amount of Contract: \$ _____	Contract Type:	
Approximate Starting Date: ____/____/____	<input type="checkbox"/> (01) General Construction	
Approximate Completion Date: ____/____/____	<input type="checkbox"/> (02) Heating/Ventilation	
	<input type="checkbox"/> (03) Electrical	
	<input type="checkbox"/> (04) Plumbing	
	<input type="checkbox"/> (05) Other : _____	

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12226

Social Security Numbers on Certified Payrolls:

The Department of Labor is cognizant of the concerns of the potential for misuse or inadvertent disclosure of social security numbers. Identity theft is a growing problem and we are sympathetic to contractors' concern regarding inclusion of this information on payrolls if another identifier will suffice.

For these reasons, the substitution of the use of the last four digits of the social security number on certified payrolls submitted to contracting agencies on public work projects is now acceptable to the Department of Labor. This change does not affect the Department's ability to request and receive the entire social security number from employers during its public work/ prevailing wage investigations.

Construction Industry Fair Play Act: Required Posting for Labor Law Article 25-B § 861-d

Construction industry employers must post the "Construction Industry Fair Play Act" notice in a prominent and accessible place on the job site. Failure to post the notice can result in penalties of up to \$1,500 for a first offense and up to \$5,000 for a second offense. The posting is included as part of this wage schedule. Additional copies may be obtained from the NYS DOL website, <https://dol.ny.gov/public-work-and-prevailing-wage>

If you have any questions concerning the Fair Play Act, please call the State Labor Department toll-free at 1-866-435-1499 or email us at: dol.misclassified@labor.ny.gov .

Worker Notification: (Labor Law §220, paragraph a of subdivision 3-a)

Effective June 23, 2020

This provision is an addition to the existing wage rate law, Labor Law §220, paragraph a of subdivision 3-a. It requires contractors and subcontractors to provide written notice to all laborers, workers or mechanics of the *prevailing wage and supplement rate* for their particular job classification *on each pay stub**. It also requires contractors and subcontractors to *post a notice* at the beginning of the performance of every public work contract *on each job site* that includes the telephone number and address for the Department of Labor and a statement informing laborers, workers or mechanics of their right to contact the Department of Labor if he/she is not receiving the proper prevailing rate of wages and/or supplements for his/her job classification. The required notification will be provided with each wage schedule, may be downloaded from our website www.labor.ny.gov or be made available upon request by contacting the Bureau of Public Work at 518-457-5589. *In the event the required information will not fit on the pay stub, an accompanying sheet or attachment of the information will suffice.

(12.20)

**To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND**

Budget Policy & Reporting Manual

B-610

Public Work Enforcement Fund

effective date December 7, 2005

1. Purpose and Scope:

This Item describes the Public Work Enforcement Fund (the Fund, PWEF) and its relevance to State agencies and public benefit corporations engaged in construction or reconstruction contracts, maintenance and repair, and announces the recently-enacted increase to the percentage of the dollar value of such contracts that must be deposited into the Fund. This item also describes the roles of the following entities with respect to the Fund:

- New York State Department of Labor (DOL),
- The Office of the State of Comptroller (OSC), and
- State agencies and public benefit corporations.

2. Background and Statutory References:

DOL uses the Fund to enforce the State's Labor Law as it relates to contracts for construction or reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law. State agencies and public benefit corporations participating in such contracts are required to make payments to the Fund.

Chapter 511 of the Laws of 1995 (as amended by Chapter 513 of the Laws of 1997, Chapter 655 of the Laws of 1999, Chapter 376 of the Laws of 2003 and Chapter 407 of the Laws of 2005) established the Fund.

3. Procedures and Agency Responsibilities:

The Fund is supported by transfers and deposits based on the value of contracts for construction and reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law, into which all State agencies and public benefit corporations enter.

Chapter 407 of the Laws of 2005 increased the amount required to be provided to this fund to .10 of one-percent of the total cost of each such contract, to be calculated at the time agencies or public benefit corporations enter into a new contract or if a contract is amended. The provisions of this bill became effective August 2, 2005.

**To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND**

OSC will report to DOL on all construction-related ("D") contracts approved during the month, including contract amendments, and then DOL will bill agencies the appropriate assessment monthly. An agency may then make a determination if any of the billed contracts are exempt and so note on the bill submitted back to DOL. For any instance where an agency is unsure if a contract is or is not exempt, they can call the Bureau of Public Work at the number noted below for a determination. Payment by check or journal voucher is due to DOL within thirty days from the date of the billing. DOL will verify the amounts and forward them to OSC for processing.

For those contracts which are not approved or administered by the Comptroller, monthly reports and payments for deposit into the Public Work Enforcement Fund must be provided to the Administrative Finance Bureau at the DOL within 30 days of the end of each month or on a payment schedule mutually agreed upon with DOL.

Reports should contain the following information:

- Name and billing address of State agency or public benefit corporation;
- State agency or public benefit corporation contact and phone number;
- Name and address of contractor receiving the award;
- Contract number and effective dates;
- Contract amount and PWEF assessment charge (if contract amount has been amended, reflect increase or decrease to original contract and the adjustment in the PWEF charge); and
- Brief description of the work to be performed under each contract.

Checks and Journal Vouchers, payable to the "New York State Department of Labor" should be sent to:

Department of Labor
Administrative Finance Bureau-PWEF Unit
Building 12, Room 464
State Office Campus
Albany, NY 12226

Any questions regarding billing should be directed to NYSDOL's Administrative Finance Bureau-PWEF Unit at (518) 457-3624 and any questions regarding Public Work Contracts should be directed to the Bureau of Public Work at (518) 457-5589.

Required Notice under Article 25-B of the Labor Law

**Attention All Employees, Contractors and Subcontractors:
You are Covered by the Construction Industry Fair Play Act**

The law says that you are an employee unless:

- You are free from direction and control in performing your job, **and**
- You perform work that is not part of the usual work done by the business that hired you, **and**
- You have an independently established business.

Your employer cannot consider you to be an independent contractor unless all three of these facts apply to your work.

It is against the law for an employer to misclassify employees as independent contractors or pay employees off the books.

Employee Rights: If you are an employee, you are entitled to state and federal worker protections. These include:

- Unemployment Insurance benefits, if you are unemployed through no fault of your own, able to work, and otherwise qualified,
- Workers' compensation benefits for on-the-job injuries,
- Payment for wages earned, minimum wage, and overtime (under certain conditions),
- Prevailing wages on public work projects,
- The provisions of the National Labor Relations Act, and
- A safe work environment.

It is a violation of this law for employers to retaliate against anyone who asserts their rights under the law. Retaliation subjects an employer to civil penalties, a private lawsuit or both.

Independent Contractors: If you are an independent contractor, **you must pay all taxes and Unemployment Insurance contributions required by New York State and Federal Law.**

Penalties for paying workers off the books or improperly treating employees as independent contractors:

- **Civil Penalty** First offense: Up to \$2,500 per employee
 Subsequent offense(s): Up to \$5,000 per employee
- **Criminal Penalty** First offense: Misdemeanor - up to 30 days in jail, up to a \$25,000 fine and debarment from performing public work for up to one year.
 Subsequent offense(s): Misdemeanor - up to 60 days in jail or up to a \$50,000 fine and debarment from performing public work for up to 5 years.

If you have questions about your employment status or believe that your employer may have violated your rights and you want to file a complaint, call the Department of Labor at (866) 435-1499 or send an email to dol.misclassified@labor.ny.gov. All complaints of fraud and violations are taken seriously. You can remain anonymous.

Employer Name:

IA 999 (09/16)



Attention Employees

THIS IS A: **PUBLIC WORK PROJECT**

If you are employed on this project as a **worker, laborer, or mechanic** you are entitled to receive the **prevailing wage and supplements rate** for the classification at which you are working.

Your pay stub and wage notice received upon hire must clearly state your wage rate and supplement rate.

Chapter 629 of the Labor Laws of 2007:

These wages are set by law and must be posted at the work site. They can also be found at:
<https://dol.ny.gov/bureau-public-work>



If you feel that you have not received proper wages or benefits, please call our nearest office.*

Albany	(518) 457-2744	Patchogue	(631) 687-4882
Binghamton	(607) 721-8005	Rochester	(585) 258-4505
Buffalo	(716) 847-7159	Syracuse	(315) 428-4056
Garden City	(516) 228-3915	Utica	(315) 793-2314
New York City	(212) 932-2419	White Plains	(914) 997-9507
Newburgh	(845) 568-5287		

* For New York City government agency construction projects, please contact the Office of the NYC Comptroller at (212) 669-4443, or www.comptroller.nyc.gov – click on Bureau of Labor Law.

Contractor Name: _____

Project Location: _____

Requirements for OSHA 10 Compliance

Article 8 §220-h requires that when the advertised specifications, for every contract for public work, is \$250,000.00 or more the contract must contain a provision requiring that every worker employed in the performance of a public work contract shall be certified as having completed an OSHA 10 safety training course. The clear intent of this provision is to require that all employees of public work contractors, required to be paid prevailing rates, receive such training "prior to the performing any work on the project."

The Bureau will enforce the statute as follows:

All contractors and sub contractors must attach a copy of proof of completion of the OSHA 10 course to the first certified payroll submitted to the contracting agency and on each succeeding payroll where any new or additional employee is first listed.

Proof of completion may include but is not limited to:

- Copies of bona fide course completion card (*Note: Completion cards do not have an expiration date.*)
- Training roster, attendance record or other documentation from the certified trainer pending the issuance of the card.
- Other valid proof

**A certification by the employer attesting that all employees have completed such a course is not sufficient proof that the course has been completed.

Any questions regarding this statute may be directed to the New York State Department of Labor, Bureau of Public Work at 518-457-5589.

WICKS

Public work projects are subject to the Wicks Law requiring separate specifications and bidding for the plumbing, heating and electrical work, when the total project's threshold is \$3 million in Bronx, Kings, New York, Queens and, Richmond counties; \$1.5 million in Nassau, Suffolk and Westchester counties; and \$500,000 in all other counties.

For projects below the monetary threshold, bidders must submit a sealed list naming each subcontractor for the plumbing, HVAC and electrical and the amount to be paid to each. The list may not be changed unless the public owner finds a legitimate construction need, including a change in specifications or costs or the use of a Project Labor Agreement (PLA), and must be open to public inspection.

Allows the state and local agencies and authorities to waive the Wicks Law and use a PLA if it will provide the best work at the lowest possible price. If a PLA is used, all contractors shall participate in apprentice training programs in the trades of work it employs that have been approved by the Department of Labor (DOL) for not less than three years. They shall also have at least one graduate in the last three years and use affirmative efforts to retain minority apprentices. PLA's would be exempt from Wicks, but deemed to be public work subject to prevailing wage enforcement.

The Commissioner of Labor shall have the power to enforce separate specification requirements on projects, and may issue stop-bid orders against public owners for non-compliance.

Other new monetary thresholds, and similar sealed bidding for non-Wicks projects, would apply to certain public authorities including municipal housing authorities, NYC Construction Fund, Yonkers Educational Construction Fund, NYC Municipal Water Finance Authority, Buffalo Municipal Water Finance Authority, Westchester County Health Care Association, Nassau County Health Care Corp., Clifton-Fine Health Care Corp., Erie County Medical Center Corp., NYC Solid Waste Management Facilities, and the Dormitory Authority.

Contractors must pay subcontractors within a 7 days period.

(07.19)

Introduction to the Prevailing Rate Schedule

Information About Prevailing Rate Schedule

This information is provided to assist you in the interpretation of particular requirements for each classification of worker contained in the attached Schedule of Prevailing Rates.

Classification

It is the duty of the Commissioner of Labor to make the proper classification of workers taking into account whether the work is heavy and highway, building, sewer and water, tunnel work, or residential, and to make a determination of wages and supplements to be paid or provided. It is the responsibility of the public work contractor to use the proper rate. If there is a question on the proper classification to be used, please call the district office located nearest the project. District office locations and phone numbers are listed below.

Prevailing Wage Schedules are issued separately for "General Construction Projects" and "Residential Construction Projects" on a county-by-county basis.

General Construction Rates apply to projects such as: Buildings, Heavy & Highway, and Tunnel and Water & Sewer rates.

Residential Construction Rates generally apply to construction, reconstruction, repair, alteration, or demolition of one family, two family, row housing, or rental type units intended for residential use.

Some rates listed in the Residential Construction Rate Schedule have a very limited applicability listed along with the rate. Rates for occupations or locations not shown on the residential schedule must be obtained from the General Construction Rate Schedule. Please contact the local Bureau of Public Work office before using Residential Rate Schedules, to ensure that the project meets the required criteria.

Payrolls and Payroll Records

Contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records.

Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury.

Paid Holidays

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

Overtime

At a minimum, all work performed on a public work project in excess of eight hours in any one day or more than five days in any workweek is overtime. However, the specific overtime requirements for each trade or occupation on a public work project may differ. Specific overtime requirements for each trade or occupation are contained in the prevailing rate schedules.

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays.

The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Supplemental Benefits

Particular attention should be given to the supplemental benefit requirements. Although in most cases the payment or provision of supplements is straight time for all hours worked, some classifications require the payment or provision of supplements, or a portion of the supplements, to be paid or provided at a premium rate for premium hours worked. Supplements may also be required to be paid or provided on paid holidays, regardless of whether the day is worked. The Overtime Codes and Notes listed on the particular wage classification will indicate these conditions as required.

Effective Dates

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. The rate listed is valid until the next effective rate change or until the new annual determination which takes effect on July 1 of each year. All contractors and subcontractors are required to pay the current prevailing rates of wages and supplements. If you have any questions please contact the Bureau of Public Work or visit the New York State Department of Labor website (www.labor.ny.gov) for current wage rate information.

Apprentice Training Ratios

The following are the allowable ratios of registered Apprentices to Journey-workers.

For example, the ratio 1:1,1:3 indicates the allowable initial ratio is one Apprentice to one Journeyworker. The Journeyworker must be in place on the project before an Apprentice is allowed. Then three additional Journeyworkers are needed before a second Apprentice is allowed. The last ratio repeats indefinitely. Therefore, three more Journeyworkers must be present before a third Apprentice can be hired, and so on.

Please call Apprentice Training Central Office at (518) 457-6820 if you have any questions.

Title (Trade)	Ratio
Boilermaker (Construction)	1:1,1:4
Boilermaker (Shop)	1:1,1:3
Carpenter (Bldg.,H&H, Pile Driver/Dockbuilder)	1:1,1:4
Carpenter (Residential)	1:1,1:3
Electrical (Outside) Lineman	1:1,1:2
Electrician (Inside)	1:1,1:3
Elevator/Escalator Construction & Modernizer	1:1,1:2
Glazier	1:1,1:3
Insulation & Asbestos Worker	1:1,1:3
Iron Worker	1:1,1:4
Laborer	1:1,1:3
Mason	1:1,1:4
Millwright	1:1,1:4
Op Engineer	1:1,1:5
Painter	1:1,1:3
Plumber & Steamfitter	1:1,1:3
Roofer	1:1,1:2
Sheet Metal Worker	1:1,1:3
Sprinkler Fitter	1:1,1:2

If you have any questions concerning the attached schedule or would like additional information, please contact the nearest BUREAU of PUBLIC WORK District Office or write to:

New York State Department of Labor
 Bureau of Public Work
 State Office Campus, Bldg. 12
 Albany, NY 12226

District Office Locations:	Telephone #	FAX #
Bureau of Public Work - Albany	518-457-2744	518-485-0240
Bureau of Public Work - Binghamton	607-721-8005	607-721-8004
Bureau of Public Work - Buffalo	716-847-7159	716-847-7650
Bureau of Public Work - Garden City	516-228-3915	516-794-3518
Bureau of Public Work - Newburgh	845-568-5287	845-568-5332
Bureau of Public Work - New York City	212-932-2419	212-775-3579
Bureau of Public Work - Patchogue	631-687-4882	631-687-4902
Bureau of Public Work - Rochester	585-258-4505	585-258-4708
Bureau of Public Work - Syracuse	315-428-4056	315-428-4671
Bureau of Public Work - Utica	315-793-2314	315-793-2514
Bureau of Public Work - White Plains	914-997-9507	914-997-9523
Bureau of Public Work - Central Office	518-457-5589	518-485-1870

Westchester County General Construction

Boilermaker **01/01/2024**

JOB DESCRIPTION Boilermaker

DISTRICT 4

ENTIRE COUNTIES

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES

Per Hour:	07/01/2023	01/01/2024
Boilermaker	\$ 65.88	\$ 67.38
Repairs & Renovations	65.88	67.38

Repairs & Renovation: Includes Repairing, Renovating replacement of parts to an existing unit(s).

SUPPLEMENTAL BENEFITS

Per Hour:

Boilermaker	33.5% of hourly	33.5% of Hourly
Repair \$ Renovations	Wage Paid	Wage Paid
	+ \$ 26.49	+ \$26.85

NOTE: "Hourly Wage Paid" shall include any and all premium(s) pay.

Repairs & Renovation Includes replacement of parts and repairs & renovation of existing unit.

OVERTIME PAY

See (*B, O, **U) on OVERTIME PAGE

Note:* Includes 9th & 10th hours, double for 11th or more.

** Labor Day ONLY, if worked.

Repairs & Renovation see (B,E,Q) on OT Page

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 11, 12, 15, 25, 26, 29) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage per hour:

(1/2) Year Terms at the following percentage of Boilermaker's Wage

1st	2nd	3rd	4th	5th	6th	7th
65%	70%	75%	80%	85%	90%	95%

Supplemental Benefits Per Hour:

Apprentice(s)	33.5% of Hourly Wage Paid Plus Amount Below	33.5% of Hourly Wage Paid Plus Amount Below
1st Term	\$ 20.12	\$ 20.36
2nd Term	21.03	21.28
3rd Term	21.95	22.22
4th Term	22.83	23.12
5th Term	23.76	24.07
6th Term	24.67	25.00
7th Term	25.58	25.93

NOTE: "Hourly Wage Paid" shall include any and all premium(s)

4-5

Carpenter **01/01/2024**

JOB DESCRIPTION Carpenter

DISTRICT 8

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per hour: 07/01/2023

Piledriver \$ 59.16
+ 9.79*

Dockbuilder \$ 59.16
+ 9.79*

*This portion is not subject to overtime premiums

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 45.34

OVERTIME PAY

See (B, E2, O) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.

Apprentices See (5,6,11,13,25)

Overtime: See (5,6,11,13,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES

Wages per hour

(1)year terms:

	1st	2nd	3rd	4th
	\$25.60	\$31.20	\$39.58	\$47.97
	+ 5.30*	+ 5.30*	+ 5.30*	+ 5.30*

*This portion is not subject to overtime premiums

Supplemental benefits per hour:

All Terms: \$ 31.83

8-1556 Db

Carpenter

01/01/2024

JOB DESCRIPTION Carpenter

DISTRICT 8

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per hour: 07/01/2023

Carpet/Resilient

Floor Coverer \$ 55.05
+ 8.25*

*This portion is not subject to overtime premiums

INCLUDES HANDLING & INSTALLATION OF ARTIFICIAL TURF AND SIMILAR TURF INDOORS/OUTDOORS.

SUPPLEMENTAL BENEFITS

Per hour:

\$ 39.45

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (18, 19) on HOLIDAY PAGE.

Paid for 1st & 2nd yr.

Apprentices See (5,6,11,13,16,18,19,25)

Overtime: See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES

Wage per hour - (1) year terms:

	1st	2nd	3rd	4th
	\$ 25.20	\$ 28.20	\$ 32.45	\$ 40.33

+ 1.85* + 2.35* + 2.85* + 3.85*

*This portion is not subject to overtime premiums

Supplemental benefits per hour:

	1st	2nd	3rd	4th
	\$ 15.22	\$ 16.22	\$ 19.32	\$ 20.32

8-2287

Carpenter

01/01/2024

JOB DESCRIPTION Carpenter

DISTRICT 8

ENTIRE COUNTIES

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per Hour: 07/01/2023

Marine Construction:

Marine Diver \$ 74.03
 + 9.79*

Marine Tender \$ 53.57
 + 9.79*

*This portion is not subject to overtime premiums

SUPPLEMENTAL BENEFITS

Per Hour:

Journeyworker \$ 45.34

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (18, 19) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 13, 16, 18, 19, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

One (1) year terms.

1st year	\$ 25.60
	+ 5.30*
2nd year	31.20
	+ 5.30*
3rd year	39.58
	+ 5.30*
4th year	47.97
	+ 5.05*

*This portion is not subject to overtime premiums

Supplemental Benefits

Per Hour:

All terms \$ 31.83

8-1456MC

Carpenter

01/01/2024

JOB DESCRIPTION Carpenter

DISTRICT 8

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per hour: 07/01/2023

Building
 Millwright \$ 58.70
 + 12.62*

*This portion is not subject to overtime premiums

SUPPLEMENTAL BENEFITS

Per hour:

Millwright \$ 44.31

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (18,19) on HOLIDAY PAGE.

Overtime See (5,6,8,11,13,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES

Wages per hour:

One (1) year terms:

1st.	2nd.	3rd.	4th.
\$31.74	\$37.19	\$42.64	\$53.54
+ 6.75*	+ 7.92*	+ 9.09*	+ 11.43*

*This portion is not subject to overtime premiums

Supplemental benefits per hour:

One (1) year terms:

1st.	2nd.	3rd.	4th.
\$29.81	\$32.34	\$35.52	\$39.94

8-740.1

Carpenter

01/01/2024

JOB DESCRIPTION Carpenter

DISTRICT 8

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per Hour:

07/01/2023

Timberman \$ 54.05
 + 10.26*

*This portion not subject to overtime premiums

SUPPLEMENTAL BENEFITS

Per Hour:

07/01/2023

\$ 44.55

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.

Apprentices See (5,6,11,13,25)

Overtime: See (5,6,11,13,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES

Wages per hour:

One (1) year terms:

1st	2nd	3rd	4th
\$23.42	\$28.53	\$36.18	\$43.84
+ 5.55*	+ 5.55*	+ 5.55*	+ 5.55*

*This portion is not subject to overtime premiums

Supplemental benefits per hour:
 All terms \$ 31.54

8-1556 Tm

Carpenter **01/01/2024**

JOB DESCRIPTION Carpenter **DISTRICT 8**

ENTIRE COUNTIES
 Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Westchester

PARTIAL COUNTIES
 Orange: South of but including the following, Waterloo Mills, Slate Hill, New Hampton, Goshen, Blooming Grove, Mountainville, east to the Hudson River.
 Putnam: South of but including the following, Cold Spring, TompkinsCorner, Mahopac, Croton Falls, east to Connecticut border.
 Suffolk: West of Port Jefferson and Patchogue Road to Route 112 to the Atlantic Ocean.

WAGES
 Per hour: 07/01/2023

Core Drilling:
 Driller \$ 43.88
 + 2.50*

Driller Helper \$ 34.47
 + 2.50*

Note: Hazardous Waste Pay Differential:
 For Level C, an additional 15% above wage rate per hour
 For Level B, an additional 15% above wage rate per hour
 For Level A, an additional 15% above wage rate per hour
 Note: When required to work on water: an additional \$ 3.00 per hour.

*This portion is not subject to overtime premiums

SUPPLEMENTAL BENEFITS
 Per hour:

Driller and Helper \$ 28.85

OVERTIME PAY
 See (B, G, P) on OVERTIME PAGE

HOLIDAY
 Paid: See (5, 6) on HOLIDAY PAGE
 Overtime: See (5, 6) on HOLIDAY PAGE

8-1536-CoreDriller

Carpenter - Building / Heavy&Highway **01/01/2024**

JOB DESCRIPTION Carpenter - Building / Heavy&Highway **DISTRICT 11**

ENTIRE COUNTIES
 Putnam, Rockland, Westchester

WAGES
 WAGES:(per hour)
 Applies to CAPRENTER BUILDING/HEAVY & HIGHWAY/TUNNEL:

	07/01/2023	07/01/2024	07/01/2025	07/01/2026
Base Wage	\$ 39.80	Additional \$ 1.25**	Additional \$ 1.25**	Additional \$ 1.25**
	+\$6.71*			

*For all hours paid straight or premium.
 **To be allocated at a later date.

SHIFT DIFFERENTIAL: When it is mandated by a Government Agency irregular or off shift can be worked. The Carpenter shall receive an additional fifteen percent (15%) of wage plus applicable benefits.

SUPPLEMENTAL BENEFITS
 Per hour:

Journeyworker \$ 33.22

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

BUILDING:

Paid: See (1) on HOLIDAY PAGE.

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE.

- Holidays that fall on Sunday will be observed Monday.

HEAVY&HIGHWAY/TUNNEL:

Paid: See (5, 6, 25) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

- Holidays that fall on Sunday will be observed Monday

- Must be employed during the five (5) work days immediately preceding a holiday or during the five (5) work days following the paid holiday to receive holiday pay

- If Employee is entitled to a paid holiday, the Employee is paid the Holiday wage and supplemental benefits whether they work or not. If Employee works the Holiday, the Employee will receive holiday pay (including supplemental benefits), plus the applicable premium wage for working the Holiday. If Employee works in excess of 8 hours on Holiday, then benefits will be paid for any hours in excess of 8 hours.

REGISTERED APPRENTICES

1 year terms at the following wage rates:

1st	2nd	3rd	4th	5th
\$ 19.90	\$ 23.88	\$ 25.87	\$ 27.86	\$ 31.84
+3.58*	+3.58*	+3.58*	+3.58*	+3.58*

*For all hours paid straight or premium

SUPPLEMENTAL BENEFITS per hour:

All terms \$ 16.27

11-279.1B/HH

Electrician

01/01/2024

JOB DESCRIPTION Electrician

DISTRICT 9

ENTIRE COUNTIES

Bronx, Kings, New York, Queens, Richmond, Westchester

WAGES

Per hour: 07/01/2023 03/07/2024

Service Technician \$ 36.40 \$ 37.40

Service and Maintenance on Alarm and Security Systems.

Maintenance, repair and /or replacement of defective (or damaged) equipment on, but not limited to, Burglar - Fire - Security - CCTV - Card Access - Life Safety Systems and associated devices. (Whether by service contract of T&M by customer request.)

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker: \$ 21.07 \$ 21.85

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 11, 15, 16, 17, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 15, 16, 17, 25, 26) on HOLIDAY PAGE

9-3H

Electrician

01/01/2024

JOB DESCRIPTION Electrician

DISTRICT 8

ENTIRE COUNTIES

Westchester

WAGES

Per hour: 07/01/2023 04/18/2024 04/17/2025

*Electrician/A-Technician \$ 55.75 \$ 56.75 \$ 58.75

Teledata	55.75	56.75	58.75
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*All new installations of wiring, conduit, junction boxes and light fixtures for projects with a base bid of more than \$325,000. For projects with a base bid of \$325,000 or less, see Maintenance and Repair rates.

Note: On a job where employees are required to work on bridges over navigable waters, transmission towers, light poles, bosun chairs, swinging scaffolds, etc. 40 feet or more above the water or ground or under compressed air, or tunnel projects under construction or where assisted breathing apparatus is required, they will be paid at the rate of time and one-half for such work except on normal pole line or building construction work.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker	\$ 56.26	\$59.39	\$61.09
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OVERTIME PAY

See (A, G, *J, P) on OVERTIME PAGE

*NOTE: Emergency work on Sunday and Holidays is at the time and one-half overtime rate.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

(1) year terms at the following wage rates:

	07/01/2023	04/18/2024	04/17/2025
1st term	\$ 16.00	\$16.00	\$16.00
2nd term	17.00	17.00	17.00
3rd term	19.00	19.00	19.00
4th term	21.00	21.00	21.00
MIJ 1-12 months	26.50	26.50	26.50
MIJ 13-18 months	30.00	30.00	30.00

Supplemental Benefits per hour:

	07/01/2023	04/18/2024	04/17/2025
1st term	\$ 11.63	\$ 12.40	\$ 12.72
2nd term	14.30	15.07	15.89
3rd term	15.62	16.40	17.23
4th term	16.95	17.73	18.57
MIJ 1-12 months	13.92	15.72	15.89
MIJ 13-18 months	14.33	16.17	16.29

8-3/W

Electrician

01/01/2024

JOB DESCRIPTION Electrician

DISTRICT 8

ENTIRE COUNTIES

Westchester

WAGES

Per hour

	07/01/2023	04/18/2024	04/17/2025
Electrician -M	\$ 30.00	\$ 30.00	\$ 30.00
H - Telephone	30.00	30.00	30.00

All work with a base bid amount of \$325,000 or less. Including repairs and /or replacement of defective electrical and teledata equipment, all work necessary to retrofit, service, maintain and repair all kinds of lighting fixtures and local lighting controls, and washing and cleaning of foregoing fixtures.

*If the project exceeds \$375,000 due to changes in the scope of work, an Electrician/A Technician must be part of the labor ratio.

SUPPLEMENTAL BENEFITS

	07/01/2023	04/18/2024	04/17/2025
Electrician & H - Telephone	\$ 14.33	\$ 16.17	\$ 16.29

OVERTIME PAY

See (B, G, *J, P) on OVERTIME PAGE

*Note: Emergency work on Sunday and Holidays is at the time and one-half overtime rate.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

Elevator Constructor

01/01/2024

JOB DESCRIPTION Elevator Constructor

DISTRICT 4

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

PARTIAL COUNTIES

Rockland: Entire County except for the Township of Stony Point

Westchester: Entire County except for the Townships of Bedford, Lewisboro, Cortland, Mt. Kisco, North Salem, Pound Ridge, Somers and Yorktown.

WAGES

Per hour:

07/01/2023

Elevator Constructor \$ 77.49

Modernization & Service/Repair \$ 60.89

NOTE - The 'Employer Registration' (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per Hour:

Elevator Constructor \$ 45.574

Modernization & Service/Repairs 44.412

OVERTIME PAY

Constructor See (D, M, T) on OVERTIME PAGE.

Modern/Service See (B, F, S) on OVERTIME PAGE.

HOLIDAY

Paid: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

WAGES PER HOUR:

*Note:1st, 2nd, 3rd Terms are based on Average wage of Constructor & Modernization.

Terms 4 thru 9 Based on Journeyman's wage of classification Working in.

6 MONTH TERMS:

1st Term* 50%	2nd & 3rd Term* 50%	4th & 5th Term 55%	6th & 7th Term 65%	8th & 9th Term 75%
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SUPPLEMENTAL BENEFITS

Elevator Constructor

1st Term	\$ 0.00
2nd & 3rd Term	36.024
4th & 5th Term	36.943
6th & 7th Term	38.448
8th & 9th Term	39.953

Modernization & Service/Repair

1st Term	\$ 0.00
2nd & 3rd Term	35.694
4th & 5th Term	36.525
6th & 7th Term	37.948
8th & 9th Term	39.38

Elevator Constructor

01/01/2024

JOB DESCRIPTION Elevator Constructor

DISTRICT 1

ENTIRE COUNTIES

Columbia, Dutchess, Greene, Orange, Putnam, Sullivan, Ulster

PARTIAL COUNTIES

Delaware: Towns of Andes, Bovina, Colchester, Davenport, Delhi, Harpersfield, Hemdon, Kortright, Meredith, Middletown, Roxbury, Hancock & Stamford

Rockland: Only the Township of Stony Point.

Westchester: Only the Townships of Bedford, Lewisboro, Cortland, Mt. Kisco, North Salem, Pound Ridge, Somers and Yorktown.

WAGES

Per Hour	07/01/2023	01/01/2024
Mechanic	\$ 67.35	\$ 70.15
Helper	70% of Mechanic Wage Rate	70% of Mechanic Wage Rate

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour	07/01/2023	01/01/2024
Journeyman/Helper	\$ 37.335*	\$ 37.885*

(*)Plus 6% of regular hourly if less than 5 years of service. Plus 8% of regular hourly rate if more than 5 years of service.

OVERTIME PAY

See (D, O) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 15, 16) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16) on HOLIDAY PAGE

Note: When a paid holiday falls on Saturday, it shall be observed on Friday. When a paid holiday falls on Sunday, it shall be observed on Monday.

REGISTERED APPRENTICES

Wages per hour:

0-6 mo*	6-12 mo	2nd yr	3rd yr	4th yr
50 %	55 %	65 %	70 %	80 %

(*)Plus 6% of the hourly rate, no additional supplemental benefits.

Supplemental Benefits per hour worked:

Same as Journeyman/Helper

1-138

Glazier

01/01/2024

JOB DESCRIPTION Glazier

DISTRICT 8

ENTIRE COUNTIES

Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES

Per hour:	7/01/2023
Glazier & Glass Tinting	\$ 61.64
*Scaffolding	65.64
Window Film	
**Repair & Maintenance	30.76

*Scaffolding includes swing scaffold, mechanical equipment, scissor jacks, man lifts, booms & buckets 30' or more, but not pipe scaffolding.

**Repair & Maintenance- All repair & maintenance work on a particular building whenever performed, where the total cumulative Repair & Maintenance contract value is under \$184,000.

SUPPLEMENTAL BENEFITS

Per hour:	7/01/2023
Glazier & Glass Tinting	\$ 40.20
Window Film Repair & Maintenance	23.19

OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE
 For 'Repair & Maintenance' see (B, B2, I, S) on overtime page.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (4, 6, 16, 25) on HOLIDAY PAGE

For 'Repair & Maintenance'

Paid: See(5, 6, 16, 25)
 Overtime: See(5, 6, 16, 25)

REGISTERED APPRENTICES

Wage per hour:
 (1) year terms at the following wage rates:
 7/01/2023

1st term	\$ 21.93
2nd term	30.05
3rd term	39.95
4th term	48.97

Supplemental Benefits:
 (Per hour)

1st term	\$ 18.25
2nd term	25.97
3rd term	31.27
4th term	34.32

8-1087 (DC9 NYC)

Insulator - Heat & Frost

01/01/2024

JOB DESCRIPTION Insulator - Heat & Frost

DISTRICT 8

ENTIRE COUNTIES

Dutchess, Orange, Putnam, Rockland, Westchester

WAGES

Per hour:	07/01/2023	06/01/2024
Insulator	\$ 59.25	+ \$ 2.50
Discomfort & Additional Training**	62.31	+ \$ 2.50
Fire Stop Work*	31.77	+ \$ 2.50

* Applies on all exclusive Fire Stop Work (When contract is for Fire Stop work only). No apprentices on these contracts only.

**Applies to work requiring; garb or equipment worn against the body not customarily worn by insulators; psychological evaluation ;special training, including but not limited to "Yellow Badge" radiation training

Note: Additional \$0.50 per hour for work 30 feet or more above floor or ground level.

SUPPLEMENTAL BENEFITS

Per hour:	
Journeyworker	\$ 37.35

Discomfort & Additional Training	39.39
Fire Stop Work:	
Journeyworker	19.03

OVERTIME PAY

See (B, E, E2, Q, *T) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Note: Last working day preceding Christmas and New Years day, workers shall work no later than 12:00 noon and shall receive 8 hrs pay.

Overtime: See (2*, 4, 6, 16, 25) on HOLIDAY PAGE.

*Note: Labor Day triple time if worked.

REGISTERED APPRENTICES

(1) year terms:

Insulator Apprentices:

1st	2nd	3rd	4th
\$ 31.77	\$ 37.26	\$ 42.76	\$ 48.26

Discomfort & Additional Training Apprentices:

1st	2nd	3rd	4th
\$ 33.30	\$ 39.09	\$ 44.90	\$ 50.71

Supplemental Benefits paid per hour:

Insulator Apprentices:

1st term	\$ 19.03
2nd term	22.69
3rd term	26.36
4th term	30.03

Discomfort & Additional Training Apprentices:

1st term	\$ 20.06
2nd term	23.92
3rd term	27.78
4th term	31.66

8-91

Ironworker

01/01/2024

JOB DESCRIPTION Ironworker

DISTRICT 9

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per Hour:	07/01/2023	01/01/2024
Stone Derrickmen Rigger	\$ 72.90	Additional + \$ 1.64
Stone Handset Derrickman	70.47	+ \$ 1.11

SUPPLEMENTAL BENEFITS

Per hour:

Stone Derrickmen Rigger	\$ 43.10
Stone Handset Derrickman	42.84

OVERTIME PAY

See (B, D1, *E, Q, **V) on OVERTIME PAGE

*Time and one-half shall be paid for all work on Saturday up to eight (8) hours and double time shall be paid for all work thereafter.

** Benefits same premium as wages on Holidays only

HOLIDAY

Paid: See (18) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 25) on HOLIDAY PAGE

Work stops at schedule lunch break with full day's pay.

REGISTERED APPRENTICES

Wage per hour:

Stone Derrickmen Rigger:

	1st	2nd	3rd	4th
07/01/2023	\$ 35.90	\$ 51.53	\$ 57.32	\$ 63.11

Supplemental Benefits:

Per hour:

07/01/2023	22.11	32.58	32.58	32.58
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Stone Handset:

1/2 year terms at the following hourly wage rate:

	1st	2nd	3rd	4th
07/01/2023	34.56	49.75	55.33	60.90

Supplemental Benefits:

Per hour:

07/01/2023	22.10	32.46	32.46	32.46
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9-197D/R

Ironworker

01/01/2024

JOB DESCRIPTION Ironworker

DISTRICT 4

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per Hour: 07/01/2023

Ornamental	\$ 46.90
Chain Link Fence	46.90
Guide Rail	46.90

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker: \$ 63.04

OVERTIME PAY

See (B, B1, Q, V) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Apprentices Hired after 9/1/18:

1 year terms

	07/01/2023
1st Term	\$ 21.13
2nd Term	24.77
3rd Term	28.40
4th Term	32.06

Supplemental Benefits per hour:

1st Term	\$ 17.90
2nd Term	19.15
3rd Term	20.41
4th Term	21.67

4-580-Or

Ironworker

01/01/2024

JOB DESCRIPTION Ironworker

DISTRICT 4

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

PER HOUR:

	07/01/2023	01/01/2024	07/01/2024 Additional
Ironworker:			
Structural Bridges Machinery	\$ 57.20	\$ 57.70	\$ 1.75/Hr.*

(*)To be allocated at a later date.

SUPPLEMENTAL BENEFITS

PER HOUR PAID:

Journeyman	\$ 87.35	\$ 88.60
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OVERTIME PAY

See (B, B1, Q, *V) on OVERTIME PAGE

*NOTE: Benefits are calculated for every hour paid

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 18, 19) on HOLIDAY PAGE

REGISTERED APPRENTICES

WAGES PER HOUR:

6 month terms at the following rate:

1st	\$ 29.73	\$ 29.98
2nd	30.33	30.58
3rd - 6th	30.94	31.19

Supplemental Benefits

PER HOUR PAID:

All Terms	\$ 60.69	\$ 61.59
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4-40/361-Str

Ironworker

01/01/2024

JOB DESCRIPTION Ironworker

DISTRICT 4

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

PARTIAL COUNTIES

Rockland: Southern section - south of Convent Road and east of Blue Hills Road.

WAGES

Per hour: 07/01/2023

Reinforcing &
Metal Lathing \$ 56.95

"Base" Wage \$ 55.20
plus \$ 1.75

"Base" Wage is used to calculate overtime hours only.

SUPPLEMENTAL BENEFITS

Per hour:

Reinforcing &
Metal Lathing \$ 42.72

OVERTIME PAY

See (B, E, Q, *X) on OVERTIME PAGE

*Only \$23.50 per Hour for non worked hours

Supplemental Benefit Premiums for Overtime Hours worked:

Time & One Half \$ 49.47

Double Time \$ 56.22

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 13, *18, **19, 25) on HOLIDAY PAGE

*Note: Work performed after first 4 Hours.

REGISTERED APPRENTICES

(1) year terms at the following wage rates:

1st term	2nd term	3rd term	4th Term
Wage Per Hour: \$ 22.55	\$ 28.38	\$ 34.68	\$ 37.18
"Base" Wage \$ 21.00 plus \$1.55	\$ 26.80 plus \$1.58	\$ 33.10 plus \$1.58	\$ 35.60 plus \$1.58

"Base" Wage is used to calculate overtime hours ONLY.

SUPPLEMENTAL BENIFITS

Per Hour:

1st term	2nd term	3rd term	4th Term
\$ 18.17	\$ 21.34	\$ 22.00	\$ 22.50

4-46Reinf

Laborer - Building

01/01/2024

JOB DESCRIPTION Laborer - Building

DISTRICT 8

ENTIRE COUNTIES

Putnam, Westchester

WAGES

Per hour	07/01/2023	05/01/2024
Laborer	\$ 40.05 plus \$5.45**	+ \$ 2.00
Laborer - Asbestos & Hazardous Materials Removal	\$ 44.50*	+ \$ 2.00

* Abatement/Removal of:

- Lead based or lead containing paint on materials to be repainted is classified as Painter.
- Asbestos containing roofs and roofing material is classified as Roofer.

** This portion is not subject to overtime premium.

NOTE: Upgrade/Material condition work plan for work performed during non-outage under a wage formula of 90% wage/100% fringe benefits at nuclear power plants.

SUPPLEMENTAL BENEFITS

Per hour: 07/01/2023

Journeyworker \$ 30.50

OVERTIME PAY

See (B, E, E2, Q, *V) on OVERTIME PAGE

*Note: For Sundays and Holidays worked benefits are at the same premium as wages.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

LABORER ONLY

Hourly terms at the following wage:

Level A 0-1000	Level B 1001-2000	Level C 2001-3000	Level D 3001-4000
\$ 28.08	\$ 31.90	\$ 35.72	\$ 39.54

Supplemental Benefits per hour:

Apprentices
 All terms \$ 23.20

Laborer - Heavy&Highway

01/01/2024

JOB DESCRIPTION Laborer - Heavy&Highway

DISTRICT 8

ENTIRE COUNTIES

Putnam, Westchester

WAGES

****PUTNAM: APPLIES TO ALL HEAVY & HIGHWAY WORK EXCLUDING HIGHWAYS, STREETS, AND BRIDGES****

GROUP I: Blaster, Quarry Master, Curbs/Asphalt Screedman, Pipe Jacking and Boring Operations Operator, Qualified Dead Condition Pipe Fuser (B Mechanic)

GROUP II: Burner, Drillers(jumbo, joy, wagon, air track, hydraulic), Drill Operator, Self Contained Rotary Drill, Curbs, Raker, Bar Person, Concrete Finisher.

GROUP III: Pavement Breakers, Jeeper Operator, Jack Hammer, Pneumatic Tools (all), Gas Driller, Guniting, Railroad Spike Puller, Pipelayer, Chain Saw, Deck winches on scows, Power Buggy Operator, Power Wheelbarrow Operator, Bar Person Helper, Compressed Air lance, Water Jet Lance.

GROUP IV: Concrete Laborers, Asph. Worker, Rock Scaler, Vibrator Oper., Bit Grinder, Air Tamper, Pumps, Epoxy (adhesives, fillers and troweled on), Barco Rammer, Concrete Grinder, Crack Router Operator, Guide Rail-digging holes and placing concrete and demolition when not to be replaced, distribution of materials and tightening of bolts.

GROUP V: Drillers Helpers, Common Laborer, Mason Tenders, Signal Person, Pit Person, Truck Spotter, Powder Person, Landscape/Nursery Person, Dump Person, Temp. Heat.

GROUP VIA: Asbestos/Toxic Waste Laborer-All removal (Roads, Tunnels, Landfills, etc.) Confined space laborer, Bio-remediation, Phyto-remediation, Lead or Hazardous material, Abatement Laborer.

Wages:(per hour) 07/01/2023

GROUP I	\$ 49.55*
GROUP II	48.20*
GROUP III	47.80*
GROUP IV	47.45*
GROUP V	47.10*
GROUP VIA	49.10*
Operator Qualified	
Gas Mechanic(A Mech)	59.55*
Flagperson	40.75*

*NOTE: To calculate overtime premiums, deduct \$0.10 from above wages

SHIFT WORK: A shift premium will be paid on Public Work contracts for off-shift or irregular shift work when mandated by the NYS D.O.T. or other Governmental Agency contracts. Employees shall receive an additional 15% per hour above current rate for all regular and irregular shift work. Premium pay shall be calculated using the 15% per hour differential as base rate.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker:

First 40 Hours	
Per Hour	\$ 26.60
Over 40 Hours	
Per Hour	19.85

OVERTIME PAY

See (B, E, P, R, S) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

NOTE: For Holiday Overtime: 5, 6 - Code 'S' applies
 For Holiday Overtime: 8, 15, 25, 26 - Code 'R' applies

REGISTERED APPRENTICES

	1st term	2nd term	3rd term	4th term
	1-1000hrs	1001-2000hrs	2001-3000hrs	3001-4000hrs
07/01/2023	\$ 27.46	\$ 32.41	\$ 37.12	\$ 41.83

Supplemental Benefits per hour:

1st term	\$ 3.85 - After 40 hours: \$ 3.60
2nd term	\$ 3.95 - After 40 hours: 3.60
3rd term	\$ 4.45 - After 40 hours: 4.00
4th term	\$ 5.00 - After 40 hours: 4.50

8-60H/H

Laborer - Tunnel

01/01/2024

JOB DESCRIPTION Laborer - Tunnel

DISTRICT 11

ENTIRE COUNTIES

Columbia, Dutchess, Greene, Orange, Otsego, Putnam, Rockland, Sullivan, Ulster, Westchester

PARTIAL COUNTIES

Chenango: Townships of Columbus, Sherburne and New Berlin.

Delaware: Townships of Andes, Bovina, Middletown, Roxbury, Franklin, Hamden, Stamford, Delhi, Kortright, Harpersfield, Merideth and Davenport.

WAGES

Class 1: All support laborers/sandhogs working above the shaft or tunnel.

Class 2: All laborers/sandhogs working in the shaft or tunnel.

Class 4: Safety Miners

Class 5: Site work related to Shaft/Tunnel

WAGES: (per hour)

	07/01/2023	06/01/2024	06/01/2025
Class 1	\$ 55.55	\$ 57.05	\$ 58.55
Class 2	57.70	59.20	60.70
Class 4	64.10	65.60	67.10
Class 5	47.65	49.90	51.40

Toxic and hazardous waste, lead abatement and asbestos abatement work will be paid an additional \$ 3.00 an hour.

SHIFT DIFFERENTIAL...On all Government mandated irregular shift work:

- Employee shall be paid at time and one half the regular rate Monday through Friday.
- Saturday shall be paid at 1.65 times the regular rate.
- Sunday shall be paid at 2.15 times the regular rate.

SUPPLEMENTAL BENEFITS

Per hour:

Benefit 1	\$ 35.73	\$ 36.98	\$ 38.23
Benefit 2	51.01	TBD	TBD
Benefit 3	71.28	TBD	TBD

Benefit 1 applies to straight time hours, paid holidays not worked.

Benefit 2 applies to over 8 hours in a day (M-F), irregular shift work hours worked, and Saturday hours worked.

Benefit 3 applies to Sunday and Holiday hours worked.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 15, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16, 25) on HOLIDAY PAGE

When a recognized Holidays falls on Saturday or Sunday, holidays falling on Saturday shall be recognized or observed on Friday and holidays falling on Sunday shall be recognized or observed on Monday. Employees ordered to work on the Saturday or Sunday of the holiday or on the recognized or the observed Friday or Monday for those holidays falling on Saturday or Sunday shall receive double time the established rate and benefits for the holiday.

REGISTERED APPRENTICES

FOR APPRENTICE RATES, refer to the appropriate Laborer Heavy & Highway wage rate contained in the wage schedule for the County and location where the work is to be performed.

11-17/60/235/754Tun

Lineman Electrician

01/01/2024

JOB DESCRIPTION Lineman Electrician

DISTRICT 6

ENTIRE COUNTIES

Westchester

WAGES

A Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors, assembly of all electrical materials, conduit, pipe or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

A Groundman/Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator equipment/operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

Below rates apply to electrical overhead and underground distribution and maintenance work and overhead and underground transmission line work, electrical substations, switching structures, continuous pipe-type underground fluid or gas filled transmission conduit and cable installations, maintenance jobs or projects, railroad catenary installations and maintenance, third rail installations, the bonding of rails and the installation of fiber optic cable. (Ref #14.04.01)

NOTE: Includes Teledata Work within ten (10) feet of High Voltage Transmission Lines. Also includes digging of holes for poles, anchors, footer, and foundations for electrical equipment.

Per hour:	07/01/2023	05/06/2024
Lineman, Tech, Welder	\$ 60.41	\$ 61.91
Crane, Crawler Backhoe	60.41	61.91
Cable Splicer-Pipe Type	66.45	68.10
Digging Mach Operator	54.37	55.72
Cert. Welder-Pipe Type	63.43	65.01
Tractor Trailer Driver	51.35	52.62
Groundman, Truck Driver	48.33	49.53
Equipment Mechanic	48.33	49.53
Flagman	36.25	37.15

Additional \$1.00 per hour for entire crew when a helicopter is used.

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT	8:00 AM TO 4:30 PM REGULAR RATE
2ND SHIFT	4:30 PM TO 1:00 AM REGULAR RATE PLUS 17.3%
3RD SHIFT	12:30 AM TO 9:00 AM REGULAR RATE PLUS 31.4%

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour worked (but also required on non-worked holidays):

	07/01/2023	05/06/2024
Lineman, Technician, or Equipment Operators with Crane License	\$ 29.40 *plus 7% of the hourly wage paid	\$ 30.90 *plus 7% of the hourly wage paid
All other Journeyman	\$ 26.40 *plus 7% of the hourly wage paid	\$ 26.90 *plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

OVERTIME PAY

See (B, E, Q,) on OVERTIME PAGE. *Note* Double time for emergency work designated by the Dept of Jurisdiction.
 NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked.
 Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.
 Overtime See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyman Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

07/01/2023	05/06/2024
\$ 26.40	\$ 26.90
*plus 7% of the hourly wage paid	*plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249aWest

Lineman Electrician - Teledata

01/01/2024

JOB DESCRIPTION Lineman Electrician - Teledata

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

Per hour:

For outside work, stopping at first point of attachment (demarcation).

	07/01/2023	01/01/2024	01/01/2025
Cable Splicer	\$ 37.73	\$ 39.24	\$ 40.81
Installer, Repairman	\$ 35.81	\$ 37.24	\$ 38.73
Teledata Lineman	\$ 35.81	\$ 37.24	\$ 38.73
Tech., Equip. Operator	\$ 35.81	\$ 37.24	\$ 38.73
Groundman	\$ 18.98	\$ 19.74	\$ 20.53

NOTE: EXCLUDES Teledata work within ten (10) feet of High Voltage (600 volts and over) transmission lines. For this work please see LINEMAN.

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED:

1ST SHIFT	REGULAR RATE
2ND SHIFT	REGULAR RATE PLUS 10%
3RD SHIFT	REGULAR RATE PLUS 15%

SUPPLEMENTAL BENEFITS

Per hour:	07/01/2023	01/01/2024	01/01/2025
Journeyman	\$ 5.70	\$ 5.70	\$ 5.70
	*plus 3% of the hourly wage paid	*plus 3% of the hourly wage paid	*plus 3% of the hourly wage paid

*The 3% is based on the hourly wage paid, straight time rate or premium rate.

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 16) on HOLIDAY PAGE

6-1249LT - Teledata

Lineman Electrician - Traffic Signal, Lighting

01/01/2024

JOB DESCRIPTION Lineman Electrician - Traffic Signal, Lighting

DISTRICT 6

ENTIRE COUNTIES

Westchester

WAGES

Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors which includes, but is not limited to road loop wires; conduit and plastic or other type pipes that carry conductors, flex cables and connectors, and to oversee the encasement or burial of such conduits or pipes.

A Groundman/Groundman Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator/equipment operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

A flagger's duties shall consist of traffic control only.
 (Ref #14.01.03)

Per hour:	07/01/2023	05/06/2024
Lineman, Technician	\$ 54.73	\$ 55.95
Crane, Crawler Backhoe	54.73	55.95
Certified Welder	57.47	58.75
Digging Machine	49.26	50.36
Tractor Trailer Driver	46.52	47.56
Groundman, Truck Driver	43.78	44.76
Equipment Mechanic	43.78	44.76
Flagman	32.84	33.57

Above rates are applicable for installation, testing, operation, maintenance and repair on all Traffic Control (Signal) and Illumination (Lighting) projects, Traffic Monitoring Systems, and Road Weather Information Systems. Includes digging of holes for poles, anchors, footer foundations for electrical equipment; assembly of all electrical materials or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

NOTE: THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT	8:00 AM TO 4:30 PM REGULAR RATE
2ND SHIFT	4:30 PM TO 1:00 AM REGULAR RATE PLUS 17.3%
3RD SHIFT	12:30 AM TO 9:00 AM REGULAR RATE PLUS 31.4%

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30, 2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour worked (but also required on non-worked holidays):

	07/01/2023	05/06/2024
Lineman, Technician,	\$ 29.40	\$ 30.90

or Equipment Operators with Crane License	*plus 7% of the hourly wage paid	*plus 7% of the hourly wage paid
All other Journeyman	\$ 26.40 *plus 7% of the hourly wage paid	\$ 26.90 *plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE. *Note* Double time for emergency work designated by the Dept. of Jurisdiction.
 NOTE: WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked.
 Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (5, 6, 8, 13, 25) on HOLIDAY PAGE and Governor of NYS Election Day.
 Overtime: See (5, 6, 8, 13, 25) on HOLIDAY PAGE and Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyman Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

	07/01/2023	05/06/2024
	\$ 26.40	\$ 26.90
	*plus 7% of the hourly wage paid	*plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249aWestLT

Mason - Building

01/01/2024

JOB DESCRIPTION Mason - Building	DISTRICT 9		
ENTIRE COUNTIES Nassau, Rockland, Suffolk, Westchester			
WAGES			
Per hour:	07/01/2023	12/04/2023	06/05/2024
Tile Setters	\$ 62.98	\$ 63.50	Additional \$ 0.72
SUPPLEMENTAL BENEFITS			
Per Hour:	\$ 25.61*	\$25.81*	
	+ \$10.04	+ \$10.04	

* This portion of benefits subject to same premium rate as shown for overtime wages.

OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE
 Work beyond 10 hours on Saturday shall be paid at double the hourly wage rate.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage per hour:

(750 hour) term at the following wage rate:

Term:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
1-750	751-1500	1501-2250	2251-3000	3001-3750	3751-4500	4501-5250	5251-6000	6001-6750	6501-7000

07/01/2023	\$21.70	\$26.66	\$33.75	\$38.69	\$42.25	\$45.70	\$49.29	\$54.23	\$57.09	\$61.25
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12/04/2023	\$21.96	\$26.95	\$34.10	\$39.08	\$42.68	\$46.16	\$49.79	\$54.77	57.66	\$61.90
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Supplemental Benefits per hour:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
07/01/2023	\$12.55*	\$12.55*	\$15.36*	\$15.36*	\$16.36*	\$17.86*	\$18.86*	\$18.86*	\$16.86*	\$22.11*
	+\$0.73	+\$0.78	+\$0.88	+\$0.88	+\$1.37	+\$1.42	+\$1.83	+\$1.88	+\$6.03	+\$6.61

12/04/2023	\$12.55*	\$12.55*	\$15.63*	\$15.36*	\$16.36*	\$17.86*	\$18.86*	\$18.86*	\$16.86*	\$22.11*
	+\$0.73	+\$0.78	+\$0.89	+\$0.94	+\$1.38	+\$1.43	+\$1.84	+\$1.89	+\$6.04	+\$6.62

* This portion of benefits subject to same premium rate as shown for overtime wages.

9-7/52A

Mason - Building **01/01/2024**

JOB DESCRIPTION Mason - Building

DISTRICT 11

ENTIRE COUNTIES
 Putnam, Rockland, Westchester

PARTIAL COUNTIES
 Orange: Only the Township of Tuxedo.

WAGES

Per hour:

07/01/2023

Bricklayer	\$ 45.89
Cement Mason	45.89
Plasterer/Stone Mason	45.89
Pointer/Caulker	45.89

Additional \$1.00 per hour for power saw work
 Additional \$0.50 per hour for swing scaffold or staging work

SHIFT WORK: When shift work or an irregular workday is mandated or required by state, federal, county, local or other governmental agency contracts, the following premiums apply:

- Irregular workday requires 15% premium
- Second shift an additional 15% of wage plus benefits to be paid
- Third shift an additional 25% of wage plus benefits to be paid

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 37.95
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OVERTIME PAY

OVERTIME:

Cement Mason	See (B, E, Q, W) on OVERTIME PAGE.
All Others	See (B, E, Q) on OVERTIME PAGE.

HOLIDAY

Paid:	See (1) on HOLIDAY PAGE
Overtime:	See (5, 6, 16, 25) on HOLIDAY PAGE

Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

REGISTERED APPRENTICES

Wages per hour:

750 hour terms at the following percentage of Journeyman's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of journeyman supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Apprentices indentured before June 1st, 2011 receive full journeyman benefits

11-5wp-b

Mason - Building

01/01/2024

JOB DESCRIPTION Mason - Building

DISTRICT 9

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Building

	07/01/2023	01/01/2024
Wages per hour:		
Mosaic & Terrazzo Mechanic	\$ 60.65	\$ 60.57
Mosaic & Terrazzo Finisher	59.04	58.96

SUPPLEMENTAL BENEFITS

Per hour:

Mosaic & Terrazzo Mechanic	\$ 30.26* + \$9.16	\$ 31.36* + \$9.17
Mosaic & Terrazzo Finisher	\$ 30.26* + \$9.15	\$ 31.36* + \$9.16

*This portion of benefits subject to same premium rate as shown for overtime wages.

OVERTIME PAY

See (A, E, Q) on OVERTIME PAGE

07/01/2023- Deduct \$7.25 from hourly wages before calculating overtime.

01/01/2024- Deduct \$7.00 from hourly wages before calculating overtime.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

Easter Sunday is an observed holiday. Holidays falling on a Saturday will be observed on that Saturday. Holidays falling on a Sunday will be celebrated on the Monday.

REGISTERED APPRENTICES

Wages Per hour:

	1st 0- 1500	2nd 1501- 3000	3rd 3001- 3750	4th 3751- 4500	5th 4501- 5250	6th 5251- 6000
07/01/2023	\$ 25.82	\$ 32.19	\$ 36.39	\$ 40.38	\$ 48.52	\$ 54.59
01/01/2024	\$ 25.05	\$ 32.21	\$ 37.93	\$ 38.99	\$ 47.18	\$ 55.38

Supplemental Benefits per hour:

07/01/2023	\$6.00* +\$3.21	\$7.72* +\$4.12	\$18.16* +\$5.50	\$23.27* +\$6.41	\$24.21* +\$7.33	\$27.24* +\$8.29
01/01/2024	\$7.12* +\$3.21	\$9.16* +\$4.12	\$17.22* +\$5.51	\$25.36* +\$6.42	\$26.36* +\$7.34	\$27.36* +\$8.25

*This portion of benefits subject to same premium rate as shown for overtime wages.

Mason - Building **01/01/2024**

JOB DESCRIPTION Mason - Building **DISTRICT 9**

ENTIRE COUNTIES
 Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES
 Per hour: 07/01/2023 07/03/2023

Building-Marble Restoration:
 Marble, Stone & \$ 47.22 \$ 47.44

Terrazzo Polisher

SUPPLEMENTAL BENEFITS

Per Hour:
 Journeyworker:

Building-Marble Restoration:
 Marble, Stone &
 Polisher \$ 30.29 \$ 30.64

OVERTIME PAY

See (B, *E, Q, V) on OVERTIME PAGE
 *ON SATURDAYS, 8TH HOUR AND SUCCESSIVE HOURS PAID AT DOUBLE HOURLY RATE.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE
 1ST TERM APPRENTICE GETS PAID FOR ALL OBSERVED HOLIDAYS.

REGISTERED APPRENTICES

WAGES per hour:

900 hour term at the following wage:

1st 1- 900	2nd 901- 1800	3rd 1801- 2700	4th 2701
\$ 33.04	\$ 37.78	\$ 42.49	\$ 47.22

Supplemental Benefits Per Hour:
27.65 28.52 29.41 30.29

07/03/2023

900 hour term at the following wage:

1st 1- 900	2nd 901- 1800	3rd 1801- 2700	4th 2701
\$ 33.19	\$ 37.95	\$ 42.69	\$ 47.44

Supplemental Benefits Per Hour:
27.99 28.86 29.76 30.64

9-7/24-MP

Mason - Building **01/01/2024**

JOB DESCRIPTION Mason - Building **DISTRICT 9**

ENTIRE COUNTIES
 Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES
 Per Hour: 07/01/2023 7/03/2023

Marble Cutters & Setters \$ 62.82 \$ 63.12

SUPPLEMENTAL BENEFITS

Per Hour:

Journeyworker \$ 39.03 \$ 39.34

OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage Per Hour:

07/01/2023

750 hour terms at the following wage

1st	2nd	3rd	4th	5th	6th	7th	8th
0-3000	3001-3750	3751-4500	4501-5250	5251-6000	6001-6750	6751-7500	7500+
\$ 26.42	\$ 39.62	\$ 42.91	\$ 46.22	\$ 49.52	\$ 53.38	\$ 59.67	\$ 62.82

Supplemental Benefits per hour:

07/01/2023

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 25.38	\$ 28.86	\$ 29.74	\$ 30.60	\$ 31.48	\$ 36.44	\$ 38.17	\$ 39.03

07/03/2023

Wage Per Hour:

750 hour terms at the following wage.

1st	2nd	3rd	4th	5th	6th	7th	8th
0-3000	3001-3750	3751-4500	4501-5250	5251-6000	6001-6750	6751-7500	7500+
\$ 26.60	\$ 39.82	\$ 43.13	\$ 46.45	\$ 49.78	\$ 53.64	\$ 59.95	\$ 63.12

Supplemental Benefits Per Hour:

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 25.54	\$ 29.09	\$ 29.97	\$ 30.84	\$ 31.72	\$ 36.73	\$ 38.48	\$ 39.34

9-7/4

Mason - Building

01/01/2024

JOB DESCRIPTION Mason - Building

DISTRICT 9

ENTIRE COUNTIES

Nassau, Rockland, Suffolk, Westchester

WAGES

Per hour: 07/01/2023 12/04/2023 06/03/2024

Tile Finisher \$ 48.36 \$ 48.80 Additional \$ 0.59

SUPPLEMENTAL BENEFITS

Per Hour: \$ 22.56* \$ 22.71*
 + \$9.86 + \$9.86

*This portion of benefits subject to same premium rate as shown for overtime wages

OVERTIME PAY

See (B, E, Q, *V) on OVERTIME PAGE

*Work beyond 10 hours on a Saturday shall be paid at double the hourly wage rate.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

Mason - Building **01/01/2024**

JOB DESCRIPTION Mason - Building **DISTRICT 9**

ENTIRE COUNTIES
 Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour:	07/01/2023	07/03/2023
Marble, Stone, Maintenance Finishers:	\$ 27.26	\$ 27.44

Note 1: An additional \$2.00 per hour for time spent grinding floor using "60 grit" and below.
 Note 2: Flaming equipment operator shall be paid an additional \$25.00 per day.

SUPPLEMENTAL BENEFITS
 Per Hour:

Marble, Stone Maintenance Finishers:	\$ 14.97	\$ 15.20
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OVERTIME PAY
 See (B, *E, Q, V) on OVERTIME PAGE
 *Double hourly rate after 8 hours on Saturday

HOLIDAY
 Paid: See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE
 Overtime: See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE
 1st term apprentice gets paid for all observed holidays.

REGISTERED APPRENTICES
 WAGES per hour:

	07/01/2023	07/03/2023
0-750	\$ 21.89	\$ 22.04
751-1500	22.60	\$ 22.75
1501-2250	23.32	\$ 23.48
2251-3000	24.04	\$ 24.20
3001-3750	25.11	\$ 25.27
3751-4500	26.54	\$ 26.72
4501+	27.26	\$ 27.44

Supplemental Benefits:
 Per hour:

0-750	12.03	\$ 12.24
751-1500	12.43	\$ 12.64
1501-2250	12.82	\$ 13.03
2251-3000	13.21	\$ 13.42
3001-3750	13.80	\$ 14.02
3751-4500	14.58	\$ 14.80
4501+	14.97	\$ 15.20

9-7/24M-MF

Mason - Building / Heavy&Highway **01/01/2024**

JOB DESCRIPTION Mason - Building / Heavy&Highway **DISTRICT 9**

ENTIRE COUNTIES
 Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour:	07/01/2023	07/03/2023	01/01/2024
Marble-Finisher	\$ 49.32	\$ 49.65	\$ 49.92

SUPPLEMENTAL BENEFITS
 Journeyworker:
 Per hour

Marble- Finisher	\$ 36.62	\$ 36.67	\$ 36.93
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OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE

Work beyond 8 hours on a Saturday shall be paid at double the rate.

HOLIDAY

Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

When an observed holiday falls on a Sunday, it will be observed the next day.

9-7/20-MF

Mason - Heavy&Highway

01/01/2024

JOB DESCRIPTION Mason - Heavy&Highway

DISTRICT 11

ENTIRE COUNTIES

Putnam, Rockland, Westchester

PARTIAL COUNTIES

Orange: Only the Township of Tuxedo.

WAGES

Per hour:

07/01/2023

Bricklayer	\$ 46.39
Cement Mason	46.39
Marble/Stone Mason	46.39
Plasterer	46.39
Pointer/Caulker	46.39

Additional \$1.00 per hour for power saw work

Additional \$0.50 per hour for swing scaffold or staging work

SHIFT WORK: When shift work or an irregular workday is mandated or required by state, federal, county, local or other governmental contracts, the following rates apply:

Irregular workday requires 15% premium

Second shift an additional 15% of wage plus benefits to be paid

Third shift an additional 25% of wage plus benefits to be paid

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 37.95
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OVERTIME PAY

Cement Mason See (B, E, Q, W)

All Others See (B, E, Q,)

HOLIDAY

Paid: See (5, 6, 16, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

- Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

- Supplemental Benefits are not paid for paid Holiday

- If Holiday is worked, Supplemental Benefits are paid for hours worked.

- Whenever an Employee works within three (3) calendar days before a holiday, the Employee shall be paid for the Holiday.

REGISTERED APPRENTICES

Wages per hour:

750 hour terms at the following percentage of Journeyman's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of journeyman supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Apprentices indentured before June 1st, 2011 receive full journeyman benefits

11-5WP-H/H

Operating Engineer - Building **01/01/2024**

JOB DESCRIPTION Operating Engineer - Building **DISTRICT 9**

ENTIRE COUNTIES
Bronx, Kings, New York, Putnam, Queens, Richmond, Westchester

PARTIAL COUNTIES
Dutchess: that part of Dutchess County lying south of the North City Line of the City of Poughkeepsie.

WAGES
NOTE: Construction surveying
Party Chief--One who directs a survey party
Instrument Man--One who runs the instrument and assists Party Chief.
Rodman--One who holds the rod and assists the Survey Crew

Wages:(Per Hour) 07/01/2023

Building Construction:

Party Chief \$ 77.39
Instrument Man 61.25
Rodman 41.39

Steel Erection:

Party Chief 80.16
Instrument Man 63.60

Rodman 44.23

Heavy Construction-NYC counties only:
(Foundation, Excavation.)

Party Chief 85.74
Instrument man 64.40
Rodman 54.90

SUPPLEMENTAL BENEFITS

Per Hour: 07/01/2023

Building Construction \$ 28.04* +\$ 7.65
Steel Erection 28.64* +\$ 7.65
Heavy Construction 28.85* +\$ 7.64

* This portion subject to same premium as wages

Non-Worked Holiday Supplemental Benefit: 21.19

OVERTIME PAY

See (A, B, E, Q) on OVERTIME PAGE
Code "A" applies to Building Construction and has double the rate after 7 hours on Saturdays.
Code "B" applies to Heavy Construction and Steel Erection and had double the rate after 8 hours on Saturdays.

HOLIDAY

Paid: See (5, 6, 9, 11, 15, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 9, 11, 15, 16, 25) on HOLIDAY PAGE

9-15Db

Operating Engineer - Building **01/01/2024**

JOB DESCRIPTION Operating Engineer - Building **DISTRICT 8**

ENTIRE COUNTIES
Putnam, Westchester

PARTIAL COUNTIES

Dutchess: All the counties of Westchester and Putnam and the southern part of Dutchess County defined by the northern boundary line of the City of Poughkeepsie, then due east to Route 115, then north along Route 115 to Bedell Road, then east along Bedell Road to Van Wagner Road, then north along Van Wagner Road to Bower Road, then east along Bower Road to Route 44 and along Route 44 east to Route 343, then along Route 343 east to the northern boundary of Town of Dover Plains and east along the northern boundary of Town of Dover Plains to the border line of the State of Connecticut and bordered on the west by the middle of the Hudson River.

WAGES

GROUP I:

Cranes (All Types up to 49 tons), Boom Trucks, Cherry Pickers (All Types), Clamshell Crane, Derrick (Stone and Steel), Dragline, Franki Pile Rig or similar, High Lift (Lull or similar) with crane attachment and winch used for hoisting or lifting, Hydraulic Cranes, Pile Drivers, Potain and similar.

Cranes (All types 50-99 tons), Drill Rig Casa Grande (CAT or similar), Franki Pile Rig or similar, Hydraulic Cranes (All types including Crawler Cranes- No specific boom length).

Cranes (All types 100 tons and over), All Tower Cranes, All Climbing Cranes irrespective of manufacturer and regardless of how the same is rigged, Franki Pile Rig or similar, Conventional Cranes (All types including Crawler Cranes-No specific boom length), Hydraulic Cranes.

GROUP I-A: Barber Green Loader-Euclid Loader, Bulldozer, Carrier-Trailer Horse, Concrete Cleaning Decontamination Machine Operator, Concrete-Portable Hoist, Conway or Similar Mucking Machines, Elevator & Cage, Excavators all types, Front End Loaders, Gradall, Shovel, Backhoe, etc.(Crawler or Truck), Heavy Equipment Robotics Operator/Mechanic, Hoist Engineer-Material, Hoist Portable Mobile Unit, Hoist(Single, Double or Triple Drum), Horizontal Directional Drill Locator, Horizontal Directional Drill Operator and Jersey Spreader, Letourneau or Tournapull(Scrapers over 20 yards Struck), Lift Slab Console, etc., Lull HiLift or Similar, Master Environmental Maintenance Mechanics, Mucking Machines Operator/Mechanic or Similar Type, Overhead Crane, Pavement Breaker(Air Ram), Paver(Concrete), Post Hole Digger, Power House Plant, Road Boring Machine, Road Mix Machine, Ross Carrier and Similar Machines, Rubber tire double end backhoes and similar machines, Scoopmobile Tractor-Shovel Over 1.5 yards, Shovel (Tunnels), Spreader (Asphalt) Telephie(Cableway), Tractor Type Demolition Equipment, Trenching Machines-Vermeer Concrete Saw Trencher and Similar, Ultra High Pressure Waterjet Cutting Tool System, Vacuum Blasting Machine operator/mechanic, Winch Truck A Frame.

GROUP I-B: Compressor (Steel Erection), Mechanic (Outside All Types), Negative Air Machine (Asbestos Removal), Push Button (Buzz Box) Elevator.

GROUP II: Compactor Self-Propelled, Concrete Pump, Crane Operator in Training (Over 100 Tons), Grader, Machines Pulling Sheep's Foot Roller, Roller (4 ton and over), Scrapers (20 yards Struck and Under), Vibratory Rollers, Welder.

GROUP III-A: Asphalt Plant, Concrete Mixing Plants, Forklift (All power sources), Joy Drill or similar, Tractor Drilling Machine, Loader (1 1/2 yards and under), Portable Asphalt Plant, Portable Batch Plant, Portable Crusher, Skid Steer (Bobcat or similar), Stone Crusher, Well Drilling Machine, Well Point System.

GROUP III-B: Compressor Over 125 cu. Feet, Conveyor Belt Machine regardless of size, Compressor Plant, Ladder Hoist, Stud Machine.

GROUP IV-A: Batch Plant, Concrete Breaker, Concrete Spreader, Curb Cutter Machine, Finishing Machine-Concrete, Fine Grading Machine, Hepa Vac Clean Air Machine, Material Hopper(sand, stone, cement), Mulching Grass Spreader, Pump Gypsum etc, Pump-Plaster-GROUT-Fireproofing. Roller(Under 4 Ton),Spreading and Fine Grading Machine, Steel Cutting Machine, Siphon Pump, Tar Joint Machine, Television Cameras for Water, Sewer, Gas etc. Turbo Jet Burner or Similar Equipment, Vibrator (1 to 5).

GROUP IV-B: Compressor (all types), Heater (All Types), Fire Watchman, Lighting Unit (Portable & Generator) Pump, Pump Station(Water, Sewer, Portable, Temporary), Welding Machine (Steel Erection & Excavation).

GROUP V: Mechanics Helper, Motorized Roller (walk behind), Stock Attendant, Welder's Helper, Maintenance Engineer Crane(75 ton and over).

Group VI-A: Welder Certified

GROUP VI-B: Utility Man, Warehouse Man.

WAGES: (per hour)

	07/01/2023	03/04/2024
GROUP I		
Cranes- up to 49 tons	\$ 66.23	\$ 67.43
Cranes- 50 tons to 99 tons	68.53	69.77
Cranes- 100 tons and over	78.21	79.64
GROUP I-A	58.01	59.04
GROUP I-B	53.48	54.41
GROUP II	55.98	56.97
GROUP III-A	53.94	54.88
GROUP III-B	51.35	52.25
GROUP IV-A	53.40	54.33
GROUP IV-B	45.17	45.94
GROUP V	48.69	49.53

Group VI-A	56.96	57.96
GROUP VI-B		
Utility Man	46.21	47.00
Warehouse Man	48.52	49.26

An additional 20% to wage when required to wear protective equipment on hazardous/toxic waste projects.
 Engineers operating cranes with booms 100 feet but less than 149 feet in length will be paid an additional \$2.00 per hour.
 Engineers operating cranes with booms 149 feet or over in length will be paid an additional \$3.00 per hour.
 Loader operators over 5 cubic yard capacity additional .50 per hour.
 Shovel operators over 4 cubic yard capacity additional \$1.00 per hour.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker	\$ 31.57	\$ 32.32
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OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE
 Overtime: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

8-137B

Operating Engineer - Heavy&Highway

01/01/2024

JOB DESCRIPTION Operating Engineer - Heavy&Highway

DISTRICT 8

ENTIRE COUNTIES

Putnam, Westchester

PARTIAL COUNTIES

Dutchess: All the counties of Westchester and Putnam and the southern part of Dutchess County defined by the northern boundary line of the City of Poughkeepsie, then due east to Route 115, then north along Route 115 to Bedell Road, then east along Bedell Road to Van Wagner Road, then north along Van Wagner Road to Bower Road, then east along Bower Road to Route 44 and along Route 44 east to Route 343, then along Route 343 east to the northern boundary of Town of Dover Plains and east along the northern boundary of Town of Dover Plains to the border line of the State of Connecticut and bordered on the west by the middle of the Hudson River.

WAGES

GROUP I: Boom Truck, Cherry Picker, Clamshell, Crane, (Crawler, Truck), Dragline, Drill Rig (Casa Grande, Cat, or Similar), Floating Crane (Crane on Barges) under 100 tons, Gin Pole, Hoist Engineer-Concrete (Crane-Derrick-Mine Hoist), Knuckle Boom Crane, Rough Terrain Crane.

GROUP I-A: Auger (Truck or Truck Mounted), Boat Captain, Bulldozer-All Sizes, Central Mix Plant Operator, Chipper (all types), Close Circuit T.V., Combination Loader/Backhoe, Compactor with Blade, Concrete Finishing Machine, Gradall, Grader (Motor Grader), Elevator & Cage (Materials or Passenger), Excavator (and all attachments), Front End Loaders (1 1/2 yards and over), High Lift Lull and similar, Hoist (Single, Double, Triple Drum), Hoist Portable Mobile Unit, Hoist Engineer (Material), Jack and Bore Machine, Log Skidders, Mill Machines, Mucking Machines, Overhead Crane, Paver (concrete), Post Pounder (of any type), Push Cats, Road Reclaimer, Robot Hammer (Brokk or similar), Robotic Equipment (Scope of Engineer Schedule), Ross Carrier and similar, Scrapers (20 yard struck and over), Side Boom, Slip Form Machine, Spreader (Asphalt), Trenching Machines (Telephies-Vermeer Concrete Saw), Tractor Type Demolition Equipment, Vacuum Truck. Vibratory Roller(Riding) or Roller used in mainline paving operations.

GROUP I-B: Asphalt Mobile Conveyor/Transfer Machine, Road Paver (Asphalt).

GROUP II-A: Ballast Regulators, Compactor Self Propelled, Fusion Machine, Rail Anchor Machines, Roller (4 ton and over), Scrapers (20 yard struck and under).

GROUP II-B: Mechanic (Outside) All Types, Shop Mechanic.

GROUP III: Air Tractor Drill, Asphalt Plant, Batch Plant, Boiler (High Pressure), Concrete Breaker (Track or Rubber Tire), Concrete Pump, Concrete Spreader, Excavator Drill, Farm Tractor, Forklift (all types), Gas Tapping (Live), Hydroseeder, Loader (1 1/2 yards and under), Locomotive (all sizes), Machine Pulling Sheeps Foot Roller, Portable Asphalt Plant, Portable Batch Plant, Portable Crusher (Apprentice), Powerhouse Plant, Roller (under 4 ton), Sheer Excavator, Skid Steer/Bobcat, Stone Crusher, Sweeper (with seat), Well Drilling Machine.

GROUP IV: Service Person (Grease Truck), Deckhand.

GROUP IV-B: Conveyor Belt Machine (Truck Mounted), Heater (all types), Lighting Unit (Portable), Maintenance Engineer (For Crane Only), Mechanics Helper, Pump (Fireproofing), Pumps-Pump Station/Water/Sewer/Gypsum/Plaster, etc., Pump Truck (Sewer Jet or Similar), Welders Helper, Welding Machine (Steel Erection), Well Point System.

GROUP V: All Tower Cranes-All Climbing Cranes and all cranes of 100-ton capacity or greater (3900 Manitowac or similar) irrespective of manufacturer and regardless of how the same is rigged, Hoist Engineer (Steel), Engineer-Pile Driver, Jersey Spreader, Pavement Breaker/Post Hole Digger.

WAGES: Per hour:	07/01/2023	03/04/2024
Group I	\$ 67.27	\$ 68.63
Group I-A	59.26	60.42
Group I-B	62.46	63.70
Group II-A	56.74	57.84
Group II-B	58.52	59.67
Group III	55.74	56.81
Group IV	50.63	51.57
Group IV-B	43.43	44.19
Group V		
Engineer All Tower, Climbing and Cranes of 100 Tons	76.24	77.82
Hoist Engineer(Steel)	69.01	70.41
Engineer(Pile Driver)	73.61	75.13
Jersey Spreader, Pavement Breaker (Air Ram)Post Hole Digger	58.06	59.19

SHIFT DIFFERENTIAL:

A 15% premium on all hours paid, including overtime hours for 2nd, 3rd shifts on all government mandated off-shift work

Engineers operating cranes with booms 100 feet but less than 149 feet in length will be paid an additional \$2.00 per hour over the rate listed in the Wage Schedule. Engineers operating cranes with booms 149 feet or over in length will be paid an additional \$3.00 per hour over the rate listed in the Wage Schedule. Loader and Excavator Operators: over 5 cubic yards capacity \$0.50 per hour over the rate listed in the Wage Schedule. Shovel Operators: over 4 cubic yards capacity \$1.00 per hour over the rate listed in the Wage Schedule.

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker:	\$ 33.75 up to 40 Hours	\$ 34.85 up to 40 hours
	After 40 hours \$ 24.50* PLUS \$ 1.25 on all hours worked	After 40 hours \$ 25.55* PLUS \$ 1.25 on all hours worked

*This amount is subject to premium

OVERTIME PAY

See (B, E, P, *R, **U) on OVERTIME PAGE

HOLIDAY

Paid:..... See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

Overtime..... See (5, 6, 8, 15, 25, 26) on OVERTIME PAGE

* For Holiday codes 8,15,25,26 code R applies

** For Holiday Codes 5 & 6 code U applies

Note: If employees are required to work on Easter Sunday they shall be paid at the rate of triple time.

REGISTERED APPRENTICES

(1)year terms at the following rate.

1st term	\$ 29.63	\$ 30.21
2nd term	35.56	36.25
3rd term	41.48	42.30
4th term	47.41	48.34
Supplemental Benefits per hour:		
	25.70	26.85

Operating Engineer - Heavy&Highway

01/01/2024

JOB DESCRIPTION Operating Engineer - Heavy&Highway

DISTRICT 9

ENTIRE COUNTIES

Putnam, Westchester

PARTIAL COUNTIES

Dutchess: South of the North city line of Poughkeepsie

WAGES

Party Chief - One who directs a survey party

Instrument Man - One who runs the instrument and assists Party Chief

Rodman - One who holds the rod and in general, assists the Survey Crew

Categories cover GPS & Underground Surveying

Per Hour: 07/01/2023

Party Chief \$ 81.72

Instrument Man 61.43

Rodman 52.40

SUPPLEMENTAL BENEFITS

Per Hour: 07/01/2023

All Categories

Straight Time: \$ 25.25* + \$7.64

Premium:

Time & 1/2 \$ 37.88* + \$7.64

Double Time

\$ 50.50* + \$7.64

Non-Worked Holiday Supplemental Benefits:

\$ 21.19

OVERTIME PAY

See (B, *E, Q) on OVERTIME PAGE

* Doubletime paid on all hours in excess of 8 hours on Saturday

HOLIDAY

Paid: See (5, 6, 7, 11, 12) on HOLIDAY PAGE

Overtime: See (5, 6, 7, 11, 12) on HOLIDAY PAGE

9-15Dh

Operating Engineer - Heavy&Highway - Tunnel

01/01/2024

JOB DESCRIPTION Operating Engineer - Heavy&Highway - Tunnel

DISTRICT 8

ENTIRE COUNTIES

Putnam, Westchester

PARTIAL COUNTIES

Dutchess: All the counties of Westchester and Putnam and the southern part of Dutchess County defined by the northern boundary line of the City of Poughkeepsie, then due east to Route 115, then north along Route 115 to Bedell Road, then east along Bedell Road to Van Wagner Road, then north along Van Wagner Road to Bower Road, then east along Bower Road to Route 44 and along Route 44 east to Route 343, then along Route 343 east to the northern boundary of Town of Dover Plains and east along the northern boundary of Town of Dover Plains to the border line of the State of Connecticut and bordered on the west by the middle of the Hudson River.

WAGES

GROUP I: Boom Truck, Cherry Picker, Clamshell, Crane(Crawler, Truck), Dragline, Drill Rig Casa Grande(Cat or Similar), Floating Crane(Crane on Barge-Under 100 Tons), Hoist Engineer(Concrete/Crane-Derrick-Mine Hoist), Knuckle Boom Crane, Rough Terrain Crane.

GROUP I-A: Auger(Truck or Truck Mounted), Boat Captain, Bull Dozer-all sizes, Central Mix Plant Operator, Chipper-all types, Close Circuit T.V., Combination Loader/Backhoe, Compactor with Blade, Concrete Finishing Machine, Gradall, Grader(Motor Grader), Elevator & Cage(Materials or Passengers), Excavator(and all attachments), Front End Loaders(1 1/2 yards and over), High Lift Lull, Hoist(Single, Double, Triple Drum), Hoist Portable Mobile Unit, Hoist Engineer(Material), Jack and Bore Machine, Log Skidder, Milling Machine, Moveable Concrete Barrier Transfer & Transport Vehicle, Mucking Machines. Overhead Crane, Paver(Concrete), Post Pounder of any type, Push Cats, Road Reclaimer, Robot Hammer(Brokk or similar), Robotic Equipment(Scope of Engineer Schedule), Ross Carrier and similar machines, Scrapers(20 yards struck and over), Side Boom, Slip Form Machine, Spreader(Asphalt), Trenching Machines, Telephies-Vermeer Concrete Saw, Tractor type demolition equipment, Vacuum Truck, Vibratory Roller (Riding) used in mainline paving operations.

GROUP I-B: Asphalt Mobile Conveyor/Transfer Machine, Road Paver(Asphalt).

GROUP II-A: Ballast Regulators, Compactor(Self-propelled), Fusion Machine, Rail Anchor Machines, Roller(4 ton and over), Scrapers(20 yard struck and under).

GROUP II-B: Mechanic(outside)all types, Shop Mechanic.

GROUP III: Air Tractor Drill, Asphalt Plant, Batch Plant, Boiler(High Pressure), Concrete Breaker(Track or Rubber Tire), Concrete Pump, Concrete Spreader, Excavator Drill, Farm Tractor, Forklift(all types of power), Gas Tapping(Live), Hydroseeder, Loader(1 1/2 yards and under), Locomotive(all sizes), Machine Pulling Sheeps Foot Roller, Portable Asphalt Plant, Portable Batch Plant, Portable Crusher(Apprentice), Powerhouse Plant, Roller(under 4 ton), Sheer Excavator, Skidsteer/Bobcat, Stone Crusher, Sweeper(with seat), Well Drilling Machine.

GROUP IV-A: Service Person(Grease Truck), Deckhand.

GROUP IV-B: Conveyor Belt Machine(Truck Mounted), Heater(all types), Lighting Unit(Portable), Maintenance Engineer(for Crane only), Mechanics Helper, Pump(Fireproofing), Pumps-Pump Station/Water/Sewer/Gypsum/Plaster, etc., Pump Truck(Sewer Jet or similar), Welding Machine(Steel Erection), Welders Helper.

GROUP V-A: Engineer(all Tower Cranes, all Climbing Cranes & all Cranes of 100 ton capacity or greater),Hoist Engineer(Steel-Sub Structure), Engineer-Pile Driver, Jersey-Spreader, Pavement breaker, Post Hole Digger

WAGES: (per hour)

	07/01/2023	03/04/2024
GROUP I	\$ 67.27	\$ 68.63
GROUP I-A	59.26	60.42
GROUP I-B	62.46	63.70
GROUP II-A	56.74	57.84
GROUP II-B	58.52	59.67
GROUP III	55.74	56.81
GROUP IV-A	50.63	51.57
GROUP IV-B	43.43	44.19
GROUP V-A		
Engineer-Cranes	76.24	77.82
Engineer-Pile Driver	73.61	75.13
Hoist Engineer	69.01	70.41
Jersey Spreader/Post Hole Digger	58.06	59.19

SHIFT DIFFERENTIAL:

A 15% premium on all hours paid, including overtime hours for 2nd, 3rd shifts on all government mandated off-shift work

An additional 20% to wage when required to wear protective equipment on hazardous/toxic waste projects. Operators required to use two buckets pouring concrete on other than road pavement shall receive \$0.50 per hour over scale. Engineers operating cranes with booms 100 feet but less than 149 feet in length will be paid an additional \$2.00 per hour. Engineers operating cranes with booms 149 feet or over in length will be paid an additional \$3.00 per hour. Operators of shovels with a capacity over (4) cubic yards shall be paid an additional \$1.00 per hour. Operators of loaders with a capacity over (5) cubic yards shall be paid an additional \$0.50 per hour.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker:

\$ 33.75 up to 40 hours	\$ 34.85 up to 40 hours
After 40 hours \$24.50 plus \$1.25 on all hours worked	After 40 hours \$25.55 plus \$1.25 on all hours worked

OVERTIME PAY

See (D, O, *U, V) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

* Note: For Holiday codes 5 & 6, code U applies. For Holiday codes 8, 15, 25, 26, code R applies.

Note: If employees are required to work on Easter Sunday, they shall be paid at the rate of triple time.

REGISTERED APPRENTICES

(1)year terms at the following rates:

1st term	\$ 29.63	\$ 30.21
2nd term	35.56	36.25
3rd term	41.48	42.30
4th term	47.41	48.34

Supplemental Benefits per hour:

All terms	\$ 25.70	\$ 26.85
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8-137Tun

Operating Engineer - Marine Dredging **01/01/2024**

JOB DESCRIPTION Operating Engineer - Marine Dredging

DISTRICT 4

ENTIRE COUNTIES

Albany, Bronx, Cayuga, Clinton, Columbia, Dutchess, Essex, Franklin, Greene, Jefferson, Kings, Monroe, Nassau, New York, Orange, Oswego, Putnam, Queens, Rensselaer, Richmond, Rockland, St. Lawrence, Suffolk, Ulster, Washington, Wayne, Westchester

WAGES

These wages do not apply to Operating Engineers on land based construction projects. For those projects, please see the Operating Engineer Heavy/Highway Rates. The wage rates below for all equipment and operators are only for marine dredging work in navigable waters found in the counties listed above.

Per Hour:	07/01/2023	10/01/2023
CLASS A1 Deck Captain, Leverman Mechanical Dredge Operator Licensed Tug Operator 1000HP or more.	\$ 43.94	\$ 45.26
CLASS A2 Crane Operator (360 swing)	39.16	40.33
CLASS B Dozer, Front Loader Operator on Land	To conform to Operating Engineer Prevailing Wage in locality where work is being performed including benefits.	
CLASS B1 Derrick Operator (180 swing) Spider/Spill Barge Operator Operator II, Fill Placer, Engineer, Chief Mate, Electrician, Chief Welder, Maintenance Engineer Licensed Boat, Crew Boat Operator	38.00	39.14
CLASS B2 Certified Welder	35.77	36.84
CLASS C1 Drag Barge Operator, Steward, Mate, Assistant Fill Placer	34.79	35.83
CLASS C2 Boat Operator	33.67	34.68
CLASS D Shoreman, Deckhand, Oiler, Rodman, Scowman, Cook, Messman, Porter/Janitor	27.97	28.81

SUPPLEMENTAL BENEFITS

Per Hour:

THE FOLLOWING SUPPLEMENTAL BENEFITS APPLY TO ALL CATEGORIES

All Classes A & B	\$ 11.85 plus 6% of straight time	\$ 12.00 plus 6% of straight time
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	wage, Overtime hours add \$ 0.63	wage, Overtime hours add \$ 0.63
All Class C	\$ 11.60 plus 6% of straight time wage, Overtime hours add \$ 0.50	\$ 11.75 plus 6% of straight time wage, Overtime hours add \$ 0.50
All Class D	\$ 11.35 plus 6% of straight time wage, Overtime hours add \$ 0.38	\$ 11.60 plus 6% of straight time wage, Overtime hours add \$ 0.50

OVERTIME PAY

See (B2, F, R) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 8, 15, 26) on HOLIDAY PAGE

4-25a-MarDredge

Operating Engineer - Survey Crew - Consulting Engineer

01/01/2024

JOB DESCRIPTION Operating Engineer - Survey Crew - Consulting Engineer

DISTRICT 9

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Suffolk, Westchester

PARTIAL COUNTIES

Dutchess: That part in Dutchess County lying South of the North City line of Poughkeepsie.

WAGES

Feasibility and preliminary design surveying, any line and grade surveying for inspection or supervision of construction.

Per hour: 07/01/2023
 Survey Classifications

Party Chief \$ 47.15
 Instrument Man 39.30
 Rodman 34.35

SUPPLEMENTAL BENEFITS

Per Hour:

All Crew Members: \$ 23.15

OVERTIME PAY

OVERTIME:.... See (B, E*, Q, V) ON OVERTIME PAGE.

*Double-time paid on the 9th hour on Saturday.

HOLIDAY

Paid: See (5, 6, 7, 11, 16) on HOLIDAY PAGE
 Overtime: See (5, 6, 7, 11, 16) on HOLIDAY PAGE

9-15dconsult

Painter

01/01/2024

JOB DESCRIPTION Painter

DISTRICT 8

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour: 07/01/2023

Brush \$ 51.70*

Abatement/Removal of lead based
 or lead containing paint on
 materials to be repainted. 51.70*

Spray & Scaffold	\$ 54.70*
Fire Escape	54.70*
Decorator	54.70*
Paperhanger/Wall Coverer	54.48*

*Subtract \$ 0.10 to calculate premium rate.

SUPPLEMENTAL BENEFITS

Per hour:

Paperhanger	\$ 34.60
All others	32.73
Premium	36.70**

**Applies only to "All others" category, not paperhanger journeyworker.

OVERTIME PAY

See (A, H) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

One (1) year terms at the following wage rate.

Per hour:	07/01/2023
Appr 1st term...	\$ 19.95*
Appr 2nd term...	25.56*
Appr 3rd term...	31.05*
Appr 4th term...	41.62*

*Subtract \$ 0.10 to calculate premium rate.

Supplemental benefits:

Per Hour:	
Appr 1st term...	\$ 16.06
Appr 2nd term...	19.95
Appr 3rd term...	23.02
Appr 4th term...	29.16

8-NYDC9-B/S

Painter

01/01/2024

JOB DESCRIPTION Painter

DISTRICT 8

ENTIRE COUNTIES

Putnam, Suffolk, Westchester

PARTIAL COUNTIES

Nassau: All of Nassau except the areas described below: Atlantic Beach, Ceaderhurst, East Rockaway, Gibson, Hewlett, Hewlett Bay, Hewlett Neck, Hewlett Park, Inwood, Lawrence, Lido Beach, Long Beach, parts of Lynbrook, parts of Oceanside, parts of Valley Stream, and Woodmere. Starting on the South side of Sunrise Hwy in Valley Stream running east to Windsor and Rockaway Ave., Rockville Centre is the boundary line up to Lawson Blvd. turn right going west all the above territory. Starting at Union Turnpike and Lakeville Rd. going north to Northern Blvd. the west side of Lakeville road to Northern blvd. At Northern blvd. going east the district north of Northern blvd. to Port Washington Blvd. West of Port Washington blvd.to St.Francis Hospital then north of first traffic light to Port Washington and Sands Point, Manor HAven, Harbour Acres.

WAGES

Per hour:	07/01/2023
Drywall Taper	\$ 51.45*

*Subtract \$ 0.10 to calculate premium rate.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman	\$ 30.88
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OVERTIME PAY

See (A, H) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages - Per Hour:

1500 hour terms at the following wage rate:

1st term	\$ 19.95*
2nd term	25.56*
3rd term	31.00*
4th term	41.52*

*Subtract \$ 0.10 to calculate premium rate.

Supplemental Benefits - Per hour:

One year term (1500 hours) at the following dollar amount.

1st year	\$ 15.22
2nd year	18.90
3rd year	21.81
4th year	27.58

8-NYDCT9-DWT

Painter - Bridge & Structural Steel

01/01/2024

JOB DESCRIPTION Painter - Bridge & Structural Steel

DISTRICT 8

ENTIRE COUNTIES

Albany, Bronx, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Kings, Montgomery, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

WAGES

Per Hour:

STEEL:

Bridge Painting:	07/01/2023	10/01/2023
	\$ 54.50	\$ 56.00
	+ 10.10*	+ 10.35*

ADDITIONAL \$6.50 per hour for POWER TOOL/SPRAY, whether straight time or overtime.

NOTE: All premium wages are to be calculated on base rate per hour only.

* For the period of May 1st to November 15th, this amount is payable up to 40 hours. For the period of Nov 16th to April 30th, this amount is payable up to 50 hours. EXCEPTION: First and last week of employment, and for the weeks of Memorial Day, Independence Day and Labor Day, where the amount is paid for the actual number of hours worked (no cap).

NOTE: Generally, for Bridge Painting Contracts, ALL WORKERS on and off the bridge (including Flagmen) are to be paid Painter's Rate; the contract must be ONLY for Bridge Painting.

SHIFT WORK:

When directly specified in public agency or authority contract documents for an employer to work a second shift and works the second shift with employees other than from the first shift, all employees who work the second shift will be paid 10% of the base wage shift differential in lieu of overtime for the first eight (8) hours worked after which the employees shall be paid at time and one half of the regular wage rate.

When a single irregular work shift is mandated in the job specifications or by the contracting agency, wages shall be paid at time and one half for single shifts between the hours of 3pm-11pm or 11pm-7am.

SUPPLEMENTAL BENEFITS

Per Hour:

Journeyworker:	\$ 11.78	\$ 12.43
	+ 30.85*	+ 31.55*

* For the period of May 1st to November 15th, this amount is payable up to 40 hours. For the period of Nov 16th to April 30th, this amount is payable up to 50 hours. EXCEPTION: First and last week of employment, and for the weeks of Memorial Day, Independence Day and Labor Day, where the amount is paid for the actual number of hours worked (no cap).

OVERTIME PAY

See (B, F, R) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (4, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage - Per hour:
 Apprentices: (1) year terms.

1st year	\$ 21.80 + 4.04	\$ 22.40 + 4.14
2nd year	\$ 32.70 + 6.06	\$ 33.60 + 6.21
3rd year	\$ 43.60 + 8.08	\$ 44.80 + 8.28
Supplemental Benefits - Per hour:		
1st year	\$.90 + 12.34	\$ 1.16 + 12.62
2nd year	\$ 7.07 + 18.51	\$ 7.46 + 18.93
3rd year	\$ 9.42 + 24.68	\$ 9.94 + 25.24

NOTE: All premium wages are to be calculated on base rate per hour only.

8-DC-9/806/155-BrSS

Painter - Line Striping **01/01/2024**

JOB DESCRIPTION Painter - Line Striping

DISTRICT 8

ENTIRE COUNTIES

Albany, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Montgomery, Nassau, Orange, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

WAGES

Per hour:

Painter (Striping-Highway):	07/01/2023	01/01/2024	07/01/2024
Striping-Machine Operator*	\$ 31.53	\$ 31.53	\$ 34.12
Linerman Thermoplastic	38.34	38.34	41.12

Note: * Includes but is not limited to: Positioning of cones and directing of traffic using hand held devices. Excludes the Driver/Operator of equipment used in the maintenance and protection of traffic safety.

NOTE - The "Employer Registration" (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour paid:

Journeyworker:

Striping Machine Operator:	\$ 10.03	\$ 22.24	\$ 23.65
Linerman Thermoplastic:	10.03	22.24	23.65

OVERTIME PAY

See (B, B2, E2, F, S) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 20) on HOLIDAY PAGE
 Overtime: See (5, 20) on HOLIDAY PAGE

REGISTERED APPRENTICES

One (1) year terms at the following wage rates:

1st Term:	\$ 15.00	\$ 15.00	\$ 15.00
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2nd Term:	18.92	18.92	20.47
3rd Term:	25.22	25.22	27.30

Supplemental Benefits per hour:

1st term:	\$ 9.16	\$ 22.24	\$ 23.65
2nd Term:	10.03	22.24	23.65
3rd Term:	10.03	22.24	23.65

8-1456-LS

Painter - Metal Polisher **01/01/2024**

JOB DESCRIPTION Painter - Metal Polisher

DISTRICT 8

ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuylar, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

07/01/2023

Metal Polisher	\$ 38.18
Metal Polisher*	39.28
Metal Polisher**	42.18

*Note: Applies on New Construction & complete renovation

** Note: Applies when working on scaffolds over 34 feet.

SUPPLEMENTAL BENEFITS

Per Hour: 07/01/2023

Journeyworker:

All classification	\$ 12.34
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OVERTIME PAY

See (B, E, P, T) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE
 Overtime: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

One (1) year term at the following wage rates:

07/01/2023

1st year	\$ 16.00
2nd year	17.00
3rd year	18.00
1st year*	\$ 16.39
2nd year*	17.44
3rd year*	18.54
1st year**	\$ 18.50
2nd year**	19.50
3rd year**	20.50

*Note: Applies on New Construction & complete renovation

** Note: Applies when working on scaffolds over 34 feet.

Supplemental benefits:

Per hour:

1st year	\$ 8.69
2nd year	8.69
3rd year	8.69

8-8A/28A-MP

Plumber **01/01/2024**

JOB DESCRIPTION Plumber **DISTRICT 8**

ENTIRE COUNTIES

Putnam, Westchester

WAGES

Per hour:

07/01/2023

Plumber and

Steamfitter

\$ 62.36

SHIFT WORK:

When directly specified in public agency or authority contract documents, shift work outside the regular hours of work shall be comprised of eight (8) hours per shift not including Saturday, Sundays and holidays. One half (1/2) hour shall be allowed for lunch after the first four (4) hours of each shift. Wage and Fringes for shift work shall be straight time plus a shift premium of twenty-five (25%) percent. A minimum of five days Monday through Friday must be worked to establish shift work.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker

\$ 41.51

OVERTIME PAY

See (B, E, E2, Q, V) on OVERTIME PAGE

OVERTIME:... See on OVERTIME PAGE.

HOLIDAY

Paid:

See (1) on HOLIDAY PAGE

Overtime:

See (5, 6, 8, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

(1)year terms at the following wages:

1st Term

\$ 23.20

2nd Term

26.61

3rd Term

30.74

4th Term

43.81

5th Term

46.99

Supplemental Benefits per hour:

1st term

\$ 17.12

2nd term

19.12

3rd term

22.74

4th term

30.02

5th term

31.82

8-21.1-ST

Plumber - HVAC / Service **01/01/2024**

JOB DESCRIPTION Plumber - HVAC / Service **DISTRICT 8**

ENTIRE COUNTIES

Dutchess, Putnam, Westchester

PARTIAL COUNTIES

Delaware: Only the townships of Middletown and Roxbury

Ulster: Entire County(including Walkkill and Shawangunk Prisons) except for remainder of Town of Shawangunk and Towns of Plattekill, Marlboro, and Wawarsing.

WAGES

Per hour:

07/01/2023

HVAC Service

\$ 42.68

+ \$ 4.37*

*Note: This portion of wage is not subject to overtime premium.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker HVAC Service

\$ 28.99

OVERTIME PAY

See (B, F, R) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

HVAC SERVICE

(1)year terms at the following wages:

1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
\$ 19.32	\$ 22.91	\$ 28.56	\$ 35.13	\$ 38.15
+\$2.39*	+\$2.70*	+\$3.25*	+\$3.88*	+\$4.12*

*Note: This portion of wage is not subject to overtime premium.

Supplemental Benefits per hour:

Apprentices	07/01/2023
1st term	\$ 20.84
2nd term	22.28
3rd term	23.85
4th term	26.01
5th term	27.55

8-21.1&2-SF/Re/AC

Plumber - Jobbing & Alterations

01/01/2024

JOB DESCRIPTION Plumber - Jobbing & Alterations

DISTRICT 8

ENTIRE COUNTIES

Dutchess, Putnam, Westchester

PARTIAL COUNTIES

Ulster: Entire county (including Walkill and Shawangunk Prisons in Town of Shawangunk) EXCEPT for remainder of Town of Shawangunk, and Towns of Plattekill, Marlboro, and Wawarsing.

WAGES

Per hour: 07/01/2023
Journeyworker: \$ 48.51

Repairs, replacements and alteration work is any repair or replacement of a present plumbing system that does not change existing roughing or water supply lines.

SHIFT WORK:

When directly specified in public agency or authority contract documents, shift work outside the regular hours of work shall be comprised of eight (8) hours per shift not including Saturday, Sundays and holidays. One half (1/2) hour shall be allowed for lunch after the first four (4) hours of each shift. Wage and Fringes for shift work shall be straight time plus a shift premium of twenty-five (25%) percent. A minimum of five days Monday through Friday must be worked to establish shift work.

SUPPLEMENTAL BENEFITS

Per hour:
Journeyworker
\$ 34.76

OVERTIME PAY

See (B, *E, E2, Q, V) on OVERTIME PAGE

*When used as a make-up day, hours after 8 on Saturday shall be paid at time and one half.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

(1) year terms at the following wages:

1st year	\$ 20.92
2nd year	23.24
3rd year	25.29

4th year	35.48
5th year	37.49

Supplemental Benefits per hour:

1st year	\$ 11.45
2nd year	13.46
3rd year	17.51
4th year	23.67
5th year	25.68

8-21.3-J&A

Roofer **01/01/2024**

JOB DESCRIPTION Roofer **DISTRICT 9**

ENTIRE COUNTIES
 Bronx, Dutchess, Kings, New York, Orange, Putnam, Queens, Richmond, Rockland, Sullivan, Ulster, Westchester

WAGES

Per Hour:	07/01/2023	05/01/2024
		Additional
Roofer/Waterproofer	\$ 46.50	\$2.50
	+ \$7.00*	

* This portion is not subjected to overtime premiums.

Note: Abatement/Removal of Asbestos containing roofs and roofing material is classified as Roofer.

SUPPLEMENTAL BENEFITS

Per Hour:	\$ 31.37
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OVERTIME PAY

See (B, H) on OVERTIME PAGE

Note: An observed holiday that falls on a Sunday will be observed the following Monday.

HOLIDAY

Paid:	See (1) on HOLIDAY PAGE
Overtime:	See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

(1) year term apprentices indentured prior to 01/01/2023

	1st	2nd	3rd	4th
	\$ 16.28	\$ 23.25	\$ 27.90	\$ 34.88
		+ 3.50*	+ 4.20*	+ 5.26*
Supplements:				
	1st	2nd	3rd	4th
	\$ 4.03	\$ 15.85	\$ 18.95	\$ 23.61

* This portion is not subjected to overtime premiums.

(1) year term apprentices indentured after 01/01/2023

	1st	2nd	3rd	4th	5th
	\$ 17.67	\$ 20.93	\$ 23.25	\$ 27.90	\$ 34.88
		+ 3.16*	+ 3.50*	+ 4.20*	+ 5.26
Supplements:					
	1st	2nd	3rd	4th	5th
	\$ 7.61	\$ 14.29	\$ 15.85	\$ 18.95	\$ 23.61

* This portion is not subjected to overtime premiums.

9-8R

Sheetmetal Worker **01/01/2024**

JOB DESCRIPTION Sheetmetal Worker **DISTRICT 8**

ENTIRE COUNTIES
 Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, Westchester

WAGES

SheetMetal Worker	07/01/2023
	\$ 47.00
	+ 3.60*

*This portion is not subject to overtime premiums.

SHIFT WORK

For all NYS D.O.T. and other Governmental mandated off-shift work:
 10% increase for additional shifts for a minimum of five (5) days

SUPPLEMENTAL BENEFITS

Journeyworker \$ 45.62

OVERTIME PAY

OVERTIME:.. See (B, E, Q,) on OVERTIME PAGE.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 8, 15, 16, 23) on HOLIDAY PAGE

REGISTERED APPRENTICES

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 17.50	\$ 19.67	\$ 21.87	\$ 24.05	\$ 26.24	\$ 28.44	\$ 31.10	\$ 33.75
+ 1.44*	+ 1.62*	+ 1.80*	+ 1.98*	+ 2.16*	+ 2.34*	+ 2.52*	+ 2.70*

*This portion is not subject to overtime premiums.

Supplemental Benefits per hour:

Apprentices

1st term	\$ 19.53
2nd term	21.99
3rd term	24.42
4th term	26.88
5th term	29.32
6th term	31.75
7th term	33.72
8th term	35.71

8-38

Sheetmetal Worker 01/01/2024

JOB DESCRIPTION Sheetmetal Worker

DISTRICT 4

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per Hour: 07/01/2023

Sign Erector \$ 56.00

NOTE: Structurally Supported Overhead Highway Signs(See STRUCTURAL IRON WORKER CLASS)

SUPPLEMENTAL BENEFITS

Per Hour: 07/01/2023

Sign Erector \$ 55.66

OVERTIME PAY

See (A, F, S) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 10, 11, 12, 16, 25) on HOLIDAY PAGE
 Overtime: See (5, 6, 10, 11, 12, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Per Hour:
 6 month Terms at the following percentage of Sign Erectors wage rate:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
35%	40%	45%	50%	55%	60%	65%	70%	75%	80%

SUPPLEMENTAL BENEFITS

Per Hour:

07/01/2023	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
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\$ 14.95 \$ 16.95 \$ 18.93 \$ 20.93 \$ 28.56 \$ 31.05 \$ 33.57 \$ 36.05 \$ 38.56 \$ 41.05

4-137-SE

Sprinkler Fitter **01/01/2024**

JOB DESCRIPTION Sprinkler Fitter

DISTRICT 1

ENTIRE COUNTIES

Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, Westchester

WAGES

Per hour 07/01/2023

Sprinkler \$ 50.86
 Fitter

SUPPLEMENTAL BENEFITS

Per hour

Journey person \$ 30.19

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

Note: When a holiday falls on Sunday, the following Monday shall be considered a holiday and all work performed on either day shall be at the double time rate. When a holiday falls on Saturday, the preceding Friday shall be considered a holiday and all work performed on either day shall be at the double time rate.

REGISTERED APPRENTICES

Wages per hour

One Half Year terms at the following wage.

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 24.77	\$ 27.53	\$ 30.03	\$ 32.78	\$ 35.53	\$ 38.29	\$ 41.04	\$ 43.79	\$ 46.54	\$ 49.30

Supplemental Benefits per hour

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 8.74	\$ 8.74	\$ 20.32	\$ 20.32	\$ 20.57	\$ 20.57	\$ 20.57	\$ 20.57	\$ 20.57	\$ 20.57 1-669.2

Teamster - Building / Heavy&Highway **01/01/2024**

JOB DESCRIPTION Teamster - Building / Heavy&Highway

DISTRICT 8

ENTIRE COUNTIES

Putnam, Westchester

WAGES

GROUP A: Straight Trucks (6-wheeler and 10-wheeler), A-frame, Winch, Dynamite Seeding, Mulching, Agitator, Water, Attenuator, Light Towers, Cement (all types), Suburban, Station Wagons, Cars, Pick Ups, any vehicle carrying materials of any kind.

GROUP AA: Tack Coat

GROUP B: Tractor & Trailers (all types).

GROUP BB: Tri-Axle, 14 Wheeler

GROUP C: Low Boy (carrying equipment).

GROUP D: Fuel Trucks, Tire Trucks.

GROUP E: Off-road Equipment (over 40 tons): Athey Wagons, Belly Dumps, Articulated Dumps, Trailer Wagons.

GROUP F: Off-road Equipment (over 40 tons) Euclid, DJB.

GROUP G: Off-road Equipment (under 40 tons) Athey Wagons, Belly Articulated Dumps, Trailer Wagons.

GROUP H: Off-road Equipment (under 40 tons), Euclid.

GROUP HH: Off-road Equipment (under 40 tons) D.J.B.

GROUP I: Off-road Equipment (under 40 tons) Darts.

GROUP II: Off-road Equipment (under 40 tons) RXS.

WAGES:(per hour)

07/01/2023

GROUP A \$ 46.86*

GROUP AA	49.86*
GROUP B	47.48*
GROUP BB	46.98*
GROUP C	49.61*
GROUP D	47.31*
GROUP E	47.86*
GROUP F	48.86*
GROUP G	47.61*
GROUP H	48.23*
GROUP HH	48.61*
GROUP I	48.36*
GROUP II	48.73*

* To calculate premium wage, subtract \$.10 from the hourly wage.

Note: Fuel truck operators on construction sites addit. \$5.00 per day.
For work on hazardous/toxic waste site addit. 20% of hourly rate.

Shift Differential: When mandated by the contracting agency, DOT, or any governmental agency contracts shall receive a shift differential of fifteen (15%) above the wage rate.

NOTE: The Employer Registration (30.1) use of a '4 Day/10 Hour Work schedules' will no longer be accepted or processed. All registered projects prior to June 30,2023 will expire within the granted time frame.

For Pre-Registered Projects Four (4), Ten (10) hour days may be worked at straight time during a week, Monday thru Thursday. Friday may be used as a make-up day. Tuesday thru Friday may be worked with no make-up day. For further clarification contact your local Bureau Office.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker

First 40 hours	\$ 35.58
41st-45th hours	15.73
Over 45 hours	1.60

OVERTIME PAY

See (B, E, P, R) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 8, 15, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 25) on HOLIDAY PAGE

8-456

Welder

01/01/2024

JOB DESCRIPTION Welder

DISTRICT 1

ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

Per hour 07/01/2023

Welder: To be paid the same rate of the mechanic performing the work.*

*EXCEPTION: If a specific welder certification is required, then the 'Certified Welder' rate in that trade tag will be paid.

OVERTIME PAY

HOLIDAY

1-As Per Trade

Overtime Codes

Following is an explanation of the code(s) listed in the OVERTIME section of each classification contained in the attached schedule. Additional requirements may also be listed in the HOLIDAY section.

NOTE: Supplemental Benefits are 'Per hour worked' (for each hour worked) unless otherwise noted

- (AA) Time and one half of the hourly rate after 7 and one half hours per day
- (A) Time and one half of the hourly rate after 7 hours per day
- (B) Time and one half of the hourly rate after 8 hours per day
- (B1) Time and one half of the hourly rate for the 9th & 10th hours week days and the 1st 8 hours on Saturday.
Double the hourly rate for all additional hours
- (B2) Time and one half of the hourly rate after 40 hours per week
- (C) Double the hourly rate after 7 hours per day
- (C1) Double the hourly rate after 7 and one half hours per day
- (D) Double the hourly rate after 8 hours per day
- (D1) Double the hourly rate after 9 hours per day
- (E) Time and one half of the hourly rate on Saturday
- (E1) Time and one half 1st 4 hours on Saturday; Double the hourly rate all additional Saturday hours
- (E2) Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- (E3) Between November 1st and March 3rd Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather, provided a given employee has worked between 16 and 32 hours that week
- (E4) Saturday and Sunday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- (E5) Double time after 8 hours on Saturdays
- (F) Time and one half of the hourly rate on Saturday and Sunday
- (G) Time and one half of the hourly rate on Saturday and Holidays
- (H) Time and one half of the hourly rate on Saturday, Sunday, and Holidays
- (I) Time and one half of the hourly rate on Sunday
- (J) Time and one half of the hourly rate on Sunday and Holidays
- (K) Time and one half of the hourly rate on Holidays
- (L) Double the hourly rate on Saturday
- (M) Double the hourly rate on Saturday and Sunday
- (N) Double the hourly rate on Saturday and Holidays
- (O) Double the hourly rate on Saturday, Sunday, and Holidays
- (P) Double the hourly rate on Sunday
- (Q) Double the hourly rate on Sunday and Holidays
- (R) Double the hourly rate on Holidays
- (S) Two and one half times the hourly rate for Holidays

- (S1) Two and one half times the hourly rate the first 8 hours on Sunday or Holidays One and one half times the hourly rate all additional hours.
- (T) Triple the hourly rate for Holidays
- (U) Four times the hourly rate for Holidays
- (V) Including benefits at SAME PREMIUM as shown for overtime
- (W) Time and one half for benefits on all overtime hours.
- (X) Benefits payable on Paid Holiday at straight time. If worked, additional benefit amount will be required for worked hours. (Refer to other codes listed.)

Holiday Codes

PAID Holidays:

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

OVERTIME Holiday Pay:

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays. The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Following is an explanation of the code(s) listed in the HOLIDAY section of each classification contained in the attached schedule. The Holidays as listed below are to be paid at the wage rates at which the employee is normally classified.

- (1) None
- (2) Labor Day
- (3) Memorial Day and Labor Day
- (4) Memorial Day and July 4th
- (5) Memorial Day, July 4th, and Labor Day
- (6) New Year's, Thanksgiving, and Christmas
- (7) Lincoln's Birthday, Washington's Birthday, and Veterans Day
- (8) Good Friday
- (9) Lincoln's Birthday
- (10) Washington's Birthday
- (11) Columbus Day
- (12) Election Day
- (13) Presidential Election Day
- (14) 1/2 Day on Presidential Election Day
- (15) Veterans Day
- (16) Day after Thanksgiving
- (17) July 4th
- (18) 1/2 Day before Christmas
- (19) 1/2 Day before New Years
- (20) Thanksgiving
- (21) New Year's Day
- (22) Christmas
- (23) Day before Christmas
- (24) Day before New Year's
- (25) Presidents' Day
- (26) Martin Luther King, Jr. Day
- (27) Memorial Day
- (28) Easter Sunday

(29) Juneteenth

**New York State Department of Labor - Bureau of Public Work
State Office Building Campus
Building 12 - Room 130
Albany, New York 12226**

REQUEST FOR WAGE AND SUPPLEMENT INFORMATION

As Required by Articles 8 and 9 of the NYS Labor Law

Fax (518) 485-1870 or mail this form for new schedules or for determination for additional occupations.

This Form Must Be Typed

Submitted By:

(Check Only One)

Contracting Agency

Architect or Engineering Firm

Public Work District Office

Date:

A. Public Work Contract to be let by: (Enter Data Pertaining to Contracting/Public Agency)

1. Name and complete address (Check if new or change)

Telephone

Fax

E-Mail:

2. NY State Units (see Item 5).

01 DOT

02 OGS

03 Dormitory Authority

04 State University
Construction Fund

05 Mental Hygiene
Facilities Corp.

06 OTHER N.Y. STATE UNIT

07 City

08 Local School District

09 Special Local District, i.e.,
Fire, Sewer, Water District

10 Village

11 Town

12 County

13 Other Non-N.Y. State
(Describe)

3. SEND REPLY TO (check if new or change)
Name and complete address:

Telephone

Fax

E-Mail:

4. SERVICE REQUIRED. Check appropriate box and provide project information.

New Schedule of Wages and Supplements.

APPROXIMATE BID DATE :

Additional Occupation and/or Redetermination

PRC NUMBER ISSUED PREVIOUSLY FOR
THIS PROJECT :

OFFICE USE ONLY

B. PROJECT PARTICULARS

5. Project Title _____

Description of Work _____

Contract Identification Number _____

Note: For NYS units, the OSC Contract No. _____

6. Location of Project:

Location on Site _____

Route No/Street Address _____

Village or City _____

Town _____

County _____

7. Nature of Project - Check One:

1. New Building

2. Addition to Existing Structure

3. Heavy and Highway Construction (New and Repair)

4. New Sewer or Waterline

5. Other New Construction (Explain)

6. Other Reconstruction, Maintenance, Repair or Alteration

7. Demolition

8. Building Service Contract

8. OCCUPATION FOR PROJECT :

Construction (Building, Heavy
Highway/Sewer/Water)

Tunnel

Residential

Landscape Maintenance

Elevator maintenance

Exterminators, Fumigators

Fire Safety Director, NYC Only

Fuel Delivery

Guards, Watchmen

Janitors, Porters, Cleaners,
Elevator Operators

Moving furniture and
equipment

Trash and refuse removal

Window cleaners

Other (Describe)

9. Does this project comply with the Wicks Law involving separate bidding? YES NO

10. Name and Title of Requester

Signature



NEW YORK STATE DEPARTMENT OF LABOR
Bureau of Public Work - Debarment List

**LIST OF EMPLOYERS INELIGIBLE TO BID ON OR BE
AWARDED ANY PUBLIC WORK CONTRACT**

Under Article 8 and Article 9 of the NYS Labor Law, a contractor, sub-contractor and/or its successor shall be debarred and ineligible to submit a bid on or be awarded any public work or public building service contract/sub-contract with the state, any municipal corporation or public body for a period of five (5) years from the date of debarment when:

- Two (2) final determinations have been rendered within any consecutive six-year (6) period determining that such contractor, sub-contractor and/or its successor has WILLFULLY failed to pay the prevailing wage and/or supplements;
- One (1) final determination involves falsification of payroll records or the kickback of wages and/or supplements.

The agency issuing the determination and providing the information, is denoted under the heading 'Fiscal Officer'. DOL = New York State Department of Labor; NYC = New York City Comptroller's Office; AG = New York State Attorney General's Office; DA = County District Attorney's Office.

Debarment Database: To search for contractors, sub-contractors and/or their successors debarred from bidding or being awarded any public work contract or subcontract under NYS Labor Law Articles 8 and 9, or under NYS Workers' Compensation Law Section 141-b, access the database at this link: <https://apps.labor.ny.gov/EDList/searchPage.do>

For inquiries where WCB is listed as the "Agency", please call 1-866-546-9322

NYSDOL Bureau of Public Work Debarment List 01/09/2024

Article 8

AGENCY	Fiscal Officer	FEIN	EMPLOYER NAME	EMPLOYER DBA NAME	ADDRESS	DEBARMENT START DATE	DEBARMENT END DATE
DOL	DOL	*****5754	0369 CONTRACTORS, LLC		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL	*****4018	ADIRONDACK BUILDING RESTORATION INC.		4156 WILSON ROAD EAST TABERG NY 13471	03/26/2019	03/26/2024
DOL	AG	*****1812	ADVANCED BUILDERS & LAND DEVELOPMENT, INC.		400 OSER AVE #2300HAUPPAUGE NY 11788	09/11/2019	09/11/2024
DOL	DOL	*****1687	ADVANCED SAFETY SPRINKLER INC		261 MILL ROAD P.O BOX 296EAST AURORA NY 14052	05/29/2019	05/29/2024
DOL	NYC		ALL COUNTY SEWER & DRAIN, INC.		7 GREENFIELD DR WARWICK NY 10990	03/25/2022	03/25/2027
DOL	NYC		AMJED PARVEZ		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL		ANGELO F COKER		2610 SOUTH SALINA STREET SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		ANGELO GARCIA		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL		ANGELO TONDO		449 WEST MOMBASHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	*****4231	ANKER'S ELECTRIC SERVICE, INC.		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	NYC		ARADCO CONSTRUCTION CORP		115-46 132RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL		ARNOLD A. PAOLINI		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC		ARSHAD MEHMOOD		168-42 88TH AVENUE JAMAICA NY 11432	11/20/2019	11/20/2024
DOL	NYC		AVM CONSTRUCTION CORP		117-72 123RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	NYC		AZIDABEGUM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	*****8421	B & B DRYWALL, INC		206 WARREN AVE APT 1WHITE PLAINS NY 10603	12/14/2021	12/14/2026
DOL	NYC		BALWINDER SINGH		421 HUDSON ST SUITE C5NEW YORK NY 10014	02/20/2019	02/20/2024
DOL	DOL		BERNARD BEGLEY		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	NYC	*****2113	BHW CONTRACTING, INC.		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL	*****3627	BJB CONSTRUCTION CORP.		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	DOL	*****5078	BLACK RIVER TREE REMOVAL, LLC		29807 ANDREWS ROAD BLACK RIVER NY 13032	10/17/2023	10/17/2028
DOL	DOL	*****4512	BOB BRUNO EXCAVATING, INC		5 MORNINGSIDE DR AUBURN NY 13021	05/28/2019	05/28/2024
DOL	DOL		BOGDAN MARKOVSKI		370 W. PLEASANTVIEW AVE SUITE 2.329HACKENSACK NJ 07601	02/11/2019	02/11/2024
DOL	DOL		BRADLEY J SCHUKA		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	DOL	*****9383	C.C. PAVING AND EXCAVATING, INC.		2610 SOUTH SALINA ST SUITE 12SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL	*****4083	C.P.D. ENTERPRISES, INC		P.O BOX 281 WALDEN NY 12586	03/03/2020	03/03/2025
DOL	DOL	*****5161	CALADRI DEVELOPMENT CORP.		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	DOL	*****3391	CALI ENTERPRISES, INC.		1223 PARK STREET PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	NYC		CALVIN WALTERS		465 EAST THIRD ST MT. VERNON NY 10550	09/09/2019	09/09/2024
DOL	DOL	*****4155	CASA BUILDERS, INC.	FRIEDLANDER CONSTRUCTION	64 N PUTT CONNERS ROAD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	AG	*****7247	CENTURY CONCRETE CORP		2375 RAYNOR ST RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****0026	CHANTICLEER CONSTRUCTION LLC		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	NYC	*****2117	CHARAN ELECTRICAL ENTERPRISES		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028

NYSDOL Bureau of Public Work Debarment List 01/09/2024

Article 8

DOL	NYC		CHARLES ZAHRADKA		863 WASHINGTON STREET FRANKLIN SQUARE NY 11010	03/10/2020	03/10/2025
DOL	DOL		CHRISTOPHER GRECO		26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026
DOL	DOL		CHRISTOPHER PAPASTEFANOU A/K/A CHRIS PAPASTEFANOU		1445 COMMERCE AVE BRONX NY 10461	05/30/2019	05/30/2024
DOL	DOL		CRAIG JOHANSEN		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL	*****3228	CROSS-COUNTY LANDSCAPING AND TREE SERVICE, INC.	ROCKLAND TREE SERVICE	26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026
DOL	DOL	*****2524	CSI ELECTRICAL & MECHANICAL INC		42-32 235TH ST DOUGLSTON NY 11363	01/14/2019	01/14/2024
DOL	DOL	*****7619	DANCO CONSTRUCTION UNLIMITED INC.		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL		DANIEL ROBERT MCNALLY		7 GREENFIELD DRIVE WARWICK NY 10990	03/25/2022	03/25/2027
DOL	DOL		DARIAN L COKER		2610 SOUTH SALINA ST SUITE 2CSYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		DAVID FRIEDLANDER		64 NORTH PUTT CORNERS RD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	NYC		DAVID WEINER		14 NEW DROP LANE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL		DELPHI PAINTING & DECORATING CO INC		1445 COMMERCE AVE BRONX NY 10461	05/30/2019	05/30/2024
DOL	DOL		DINA TAYLOR		64 N PUTT CONNERS RD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	DOL	*****5175	EAGLE MECHANICAL AND GENERAL CONSTRUCTION LLC		11371 RIDGE RD WOLCOTT NY 14590	02/03/2020	02/03/2025
DOL	AG		EDWIN HUTZLER		23 NORTH HOWELLS RD BELLPORT NY 11713	08/04/2021	08/04/2026
DOL	DA		EDWIN HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****0780	EMES HEATING & PLUMBING CONTR		5 EMES LANE MONSEY NY 10952	01/20/2002	01/20/3002
DOL	NYC	*****5917	EPOCH ELECTRICAL, INC		97-18 50TH AVE CORONA NY 11368	04/19/2018	04/19/2024
DOL	DOL		FAIGY LOWINGER		11 MOUNTAIN RD 28 VAN BUREN DRMONROE NY 10950	03/20/2019	03/20/2024
DOL	DA		FREDERICK HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	NYC	*****6616	G & G MECHANICAL ENTERPRISES, LLC.		1936 HEMPSTEAD TURNPIKE EAST MEDOW NY 11554	11/29/2019	11/29/2024
DOL	DOL		GABRIEL FRASSETTI			04/10/2019	04/10/2024
DOL	NYC		GAYATRI MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	DA		GEORGE LUCEY		150 KINGS STREET BROOKLYN NY 11231	01/19/1998	01/19/2998
DOL	DOL		GIGI SCHNECKENBURGER		261 MILL RD EAST AURORA NY 14052	05/29/2019	05/29/2024
DOL	DA		GIOVANNA TRAVALJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DA	*****0213	GORILLA CONTRACTING GROUP, LLC		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028
DOL	DOL		HANS RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL		IRENE KASELIS		32 PENNINGTON AVE WALDWICK NJ 07463	05/30/2019	05/30/2024
DOL	DOL	*****9211	J. WASE CONSTRUCTION CORP.		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026
DOL	DOL		J.M.J CONSTRUCTION		151 OSTRANDER AVENUE SYRACUSE NY 13205	11/21/2022	11/21/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET	12/22/2022	12/22/2027

NYS DOL Bureau of Public Work Debarment List 01/09/2024

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DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	12/12/2022	12/12/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JAMES J. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****7993	JBS DIRT, INC.		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL	*****2435	JEFFEL D. JOHNSON	JMJ7 AND SON	5553 CAIRNSTRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JEFFEL JOHNSON ELITE CARPENTER REMODEL AND CONSTRUCTION		C2 EVERGREEN CIRCLE LIVERPOOL NY 13090	11/21/2022	11/21/2027
DOL	DOL	*****2435	JEFFREY M. JOHNSON	JMJ7 AND SON	5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	NYC		JENNIFER GUERRERO		1936 HEMPSTEAD TURNPIKE EAST MEADOW NY 11554	11/29/2019	11/29/2024
DOL	DOL		JIM PLAUGHER		17613 SANTE FE LINE ROAD WAYNEFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL		JMJ7 & SON CONSTRUCTION, LLC		5553 CAIRNS TRAIL LIVERPOOL NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 AND SONS CONTRACTORS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS		7014 13TH AVENUE BROOKLYN NY 11228	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS AND SONS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS, LLC		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JOHN GOCEK		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL		JOHN MARKOVIC		47 MANDON TERRACE HAWTHORN NJ 07506	03/29/2021	03/29/2026
DOL	DOL		JOHN WASE		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026
DOL	DOL		JON E DEYOUNG		261 MILL RD P.O BOX 296EAST AURORA NY 14052	05/29/2019	05/29/2024
DOL	DOL		JORGE RAMOS		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	DOL		JOSEPH K. SALERNO		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL		JOSEPH K. SALERNO II		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026

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DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		JRN CONSTRUCTION CO, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		JULIUS AND GITA BEHREND		5 EMES LANE MONSEY NY 10952	11/20/2002	11/20/3002
DOL	DOL		KARIN MANGIN		796 PHELPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	DOL		KATE E. CONNOR		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL		KEAN INDUSTRIES, LLC		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL	*****2959	KELC DEVELOPMENT, INC		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL		KIMBERLY F. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		KMA GROUP II, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL	*****1833	KMA GROUP INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KMA INSULATION, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KRIN HEINEMANN		2345 ROUTE 52, SUITE 2N HOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	NYC		KULWANT S. DEOL		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028
DOL	DA	*****8816	LAKE CONSTRUCTION AND DEVELOPMENT CORPORATION		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	11/07/2023	11/07/2028
DOL	AG	*****3291	LINTECH ELECTRIC, INC.		3006 TILDEN AVE BROOKLYN NY 11226	02/16/2022	02/16/2027
DOL	DOL		LOUIS A. CALICCHIA		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	NYC		LUBOMIR PETER SVOBODA		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	NYC		M & L STEEL & ORNAMENTAL IRON CORP.		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	DOL	*****2196	MAINSTREAM SPECIALTIES, INC.		11 OLD TOWN RD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DA		MANUEL P TOBIO		150 KINGS STREET BROOKLYN NY 14444	08/19/1998	08/19/2998
DOL	DA		MANUEL TOBIO		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	NYC		MARIA NUBILE		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	DOL		MATTHEW P. KILGORE		4156 WILSON ROAD EAST TABERG NY 13471	03/26/2019	03/26/2024
DOL	DOL	*****4829	MILESTONE ENVIRONMENTAL CORPORATION		704 GINESI DRIVE SUITE 29MORGANVILLE NJ 07751	04/10/2019	04/10/2024
DOL	NYC	*****9926	MILLENNIUM FIRE PROTECTION, LLC		325 W. 38TH STREET SUITE 204NEW YORK NY	11/14/2019	11/14/2024

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DOL	NYC	*****0627	MILLENNIUM FIRE SERVICES, LLC		14 NEW DROP LNE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	NYC		MUHAMMED A. HASHEM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	NYC		NAMOW, INC.		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	DOL	*****7790	NATIONAL BUILDING & RESTORATION CORP		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****1797	NATIONAL CONSTRUCTION SERVICES, INC		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	NYC		NAVIT SINGH		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		NELCO CONTRACTING, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028
DOL	DA		NICHOLAS T. ANALITIS		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****7429	NICOLAE I. BARBIR	BESTUCCO CONSTRUCTI ON, INC.	444 SCHANTZ ROAD ALLENTOWN PA 18104	09/17/2020	09/17/2025
DOL	NYC	*****5643	NYC LINE CONTRACTORS, INC.		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		PAULINE CHAHALES		935 S LAKE BLVD MAHOPAC NY 10541	03/02/2021	03/02/2026
DOL	DOL		PETER STEVENS		11 OLD TOWN ROAD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DOL		PETER STEVENS		8269 21ST ST BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	DOL	*****0466	PRECISION BUILT FENCES, INC.		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	NYC		RASHEL CONSTRUCTION CORP		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	*****1068	RATH MECHANICAL CONTRACTORS, INC.		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL	*****2633	RAW POWER ELECTRIC CORP.		3 PARK CIRCLE MIDDLETOWN NY 10940	07/11/2022	07/11/2027
DOL	DA	*****7559	REGAL CONTRACTING INC.		24 WOODBINE AVE NORTHPORT NY 11768	10/01/2020	10/01/2025
DOL	DOL		RICHARD REGGIO		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	DOL		ROBBYE BISSESAR		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	01/11/2003	01/11/3003
DOL	DOL		ROBERT A. VALERINO		3841 LANYARD COURT NEW PORT RICHEY FL 34652	07/09/2019	07/09/2024
DOL	DOL		ROBERT BRUNO		5 MORNINGSIDE DRIVE AUBURN NY 13021	05/28/2019	05/28/2024
DOL	DOL		ROMEO WARREN		161 ROBYN RD MONROE NY 10950	07/11/2022	07/11/2027
DOL	DOL		RONALD MESSEN		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	*****7172	RZ & AL INC.		198 RIDGE AVENUE VALLEY STREAM NY 11581	06/06/2022	06/06/2027
DOL	DOL	*****1365	S & L PAINTING, INC.		11 MOUNTAIN ROAD P.O BOX 408MONROE NY 10950	03/20/2019	03/20/2024
DOL	DOL		SAL FRESINA MASONRY		1935 TEALL AVENUE	07/16/2021	07/16/2026

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DOL	DOL		SAL MASONRY CONTRACTORS, INC.		(SEE COMMENTS) SYRACUSE NY 13202	07/16/2021	07/16/2026
DOL	DOL	*****9874	SALFREE ENTERPRISES INC		P.O BOX 14 2821 GARDNER RDPOMPEI NY 13138	07/16/2021	07/16/2026
DOL	DOL		SALVATORE A FRESINA A/K/A SAM FRESINA		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13218	07/16/2021	07/16/2026
DOL	DOL		SAM FRESINA		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13218	07/16/2021	07/16/2026
DOL	NYC	*****0349	SAM WATERPROOFING INC		168-42 88TH AVENUE APT.1 AJAMAICA NY 11432	11/20/2019	11/20/2024
DOL	DA	*****0476	SAMCO ELECTRIC CORP.		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	NYC	*****1130	SCANA CONSTRUCTION CORP.		863 WASHINGTON STREET FRANKLIN SQUARE NY 11010	03/10/2020	03/10/2025
DOL	DOL	*****2045	SCOTT DUFFIE	DUFFIE'S ELECTRIC, INC.	P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	DOL		SCOTT DUFFIE		P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	NYC	*****6597	SHAIRA CONSTRUCTION CORP.		421 HUDSON STREET SUITE C5NEW YORK NY 10014	02/20/2019	02/20/2024
DOL	DOL		SHULEM LOWINGER		11 MOUNTAIN ROAD 28 VAN BUREN DRMONROE NY 10950	03/20/2019	03/20/2024
DOL	DA		SILVANO TRAVALJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DOL	*****0440	SOLAR GUYS INC.		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	NYC		SOMATIE RAMSUNAHAI		115-46 132ND ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL	*****2221	SOUTH BUFFALO ELECTRIC, INC.		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC	*****3661	SPANIER BUILDING MAINTENANCE CORP		200 OAK DRIVE SYOSSET NY 11791	03/14/2022	03/14/2027
DOL	DOL		STANADOS KALOGELAS		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL	*****3496	STAR INTERNATIONAL INC		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	08/11/2003	08/11/3003
DOL	DOL	*****6844	STEAM PLANT AND CHX SYSTEMS INC.		14B COMMERCIAL AVENUE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	*****9933	STEED GENERAL CONTRACTORS, INC.		1445 COMMERCE AVE BRONX NY 10461	05/30/2019	05/30/2024
DOL	DOL	*****9528	STEEL-IT, LLC.		17613 SANTE FE LINE ROAD WAYNESFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL		STEFANOS PAPASTEFANOU, JR. A/K/A STEVE PAPASTEFANOU, JR.		256 WEST SADDLE RIVER RD UPPER SADDLE RIVER NJ 07458	05/30/2019	05/30/2024
DOL	DOL	*****3800	SUBURBAN RESTORATION CO. INC.		5-10 BANTA PLACE FAIR LAWN PLACE NJ 07410	03/29/2021	03/29/2026
DOL	DOL	*****1060	SUNN ENTERPRISES GROUP, LLC		370 W. PLEASANTVIEW AVE SUITE 2.329HACKENSACK NJ 07601	02/11/2019	02/11/2024
DOL	DOL	*****9150	SURGE INC.		8269 21ST STREET BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	DOL		SYED RAZA		198 RIDGE AVENUE NY 11581	06/06/2022	06/06/2027
DOL	DOL		TERRY THOMPSON		11371 RIDGE RD WOLCOTT NY 14590	02/03/2020	02/03/2025
DOL	DOL	*****9733	TERSAL CONSTRUCTION SERVICES INC		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13208	07/16/2021	07/16/2026
DOL	DOL		TERSAL CONTRACTORS, INC.		221 GARDNER RD P.O BOX 14POMPEI NY 13138	07/16/2021	07/16/2026
DOL	DOL		TERSAL DEVELOPMENT CORP.		1935 TEALL AVENUE SYRACUSE NY 13206	07/16/2021	07/16/2026
DOL	DOL	*****5766	THE COKER CORPORATION	COKER CORPORATIO N	2610 SOUTH SALINA ST SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		TIMOTHY PERCY		29807 ANDREWS ROAD BLACK RIVER NY 13612	10/17/2023	10/17/2028
DOL	DA	*****1050	TRI STATE CONSTRUCTION OF NY CORP		50-39 175TH PLACE FRESH MEADOWS NY 11365	03/28/2022	03/28/2027

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DOL	DOL	****8210	UPSTATE CONCRETE & MASONRY CONTRACTING CO INC		449 WEST MOMBASHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	****6418	VALHALLA CONSTRUCTION, LLC.		796 PHEPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	NYC	****2426	VICKRAM MANGRU	VICK CONSTRUCTI ON	21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	NYC		VICKRAM MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	DOL		VICTOR ALICANTI		42-32 235TH ST DOUGLSTON NY 11363	01/14/2019	01/14/2024
DOL	DOL		VIKTORIA RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	NYC	****3673	WALTERS AND WALTERS, INC.		465 EAST AND THIRD ST MT. VERNON NY 10550	09/09/2019	09/09/2024
DOL	DOL	****3296	WESTERN NEW YORK CONTRACTORS, INC.		3841 LAYNARD COURT NEW PORT RICHEY FL 34652	07/09/2019	07/09/2024
DOL	DOL	****8266	WILLIAM CHRIS MCCLENDON	MCCLENDON ASPHALT PAVING	1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM CHRIS MCCLENDON		1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM G. PROERFRIEDT		85 SPRUCEWOOD ROAD WEST BABYLON NY 11704	01/19/2021	01/19/2026
DOL	DOL	****5924	WILLIAM G. PROPHY, LLC	WGP CONTRACTIN G, INC.	54 PENTAQUIT AVE BAYSHORE NY 11706	01/19/2021	01/19/2026
DOL	DOL		XENOFON EFTHIMIADIS		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028

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DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION
Division of Engineering

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142150 ELEVATOR MODERNIZATION – 143 Grand Street

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CONTRACT NO. 20-502
DIVISION 011000 GENERAL REQUIREMENTS

SECTION 011000- DESCRIPTION OF WORK

PART 1 – GENERAL

1.1 GENERAL PROJECT DESCRIPTION

- A. The scope of work of this project generally consists of the provision of all labor, material and equipment to perform Low Rise Building Renovations and HVAC Improvements – Phase II and all related work as depicted on the accompanying Contract Drawings and the Technical Specifications.
- B. Bids shall be received in accordance with the New York State Public Bidding Laws, this project will be executed under a SINGLE-PRIME CONTRACT as defined in the General Requirements.
- C. Existing conditions are shown on the drawings to the best knowledge of the Architect. The Architect, however, cannot guarantee the correctness of the existing conditions shown and assumes no responsibility therefore. It shall be the responsibility of the Contractor to visit the site and verify all existing conditions.

1.2 REQUIREMENTS INCLUDED

- A. Construction time and phasing requirements.
- B. Proof of orders and delivery dates
- C. Intent of Documents
- D. Field Measurements
- E. Initial Submittal Requirements
- F. Design Responsibility
- G. Additional Requirements
- H. Mold and Dust Mitigation Requirements
- I. Waste Management

1.3 ASBESTOS AND LEAD PAINT AWARENESS REQUIREMENTS

- A. Contractor agrees not to use or permit the use of any asbestos containing material in or on any property belonging to the Owner.
- B. For purposes of this requirement, asbestos free shall mean free from all forms of asbestos including -actinolite, amosite, anthrophyllite, chrysotile, cricidolite and tremolite both in friable and non-friable states and without regard to the purposes for which such material is used.

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1.4 CONSTRUCTION TIME AND PHASING REQUIREMENTS

- A. The Contractor is advised the "time is of the essence" of the Contract. It is understood that the work is to be carried through to completion with the utmost speed consistent with good workmanship. Safe and legal ingress and egress shall be maintained at all times to and through the occupied portions of the construction site.
- B. Storage areas shall be completely enclosed by a fence or barricade at all times so that no staff or the public can approach the area or the equipment. Coordinate with Section 01 15 00. The Contractor shall maintain fences and barricades at all appropriate areas and at all times and shall:
 - 1. Provide signs posted on fence 20 feet on center that read "Work Area- Keep Out"
 - 2. Maintain at all times, all exits and walkways from the Building.

Where the barricade is removed for work, the Contractor performing such work shall provide adequate safety personnel to prevent unauthorized persons from approaching the work area.

1.5 PROOF OF ORDERS AND DELIVERY DATES -Coordinate w/Section 01 33 00

- A. Within 2 weeks after the approval of shop drawings, samples, product data and the like, the Contractor shall provide copies of purchase orders for all equipment and materials which are not available in local stock. The Contractor shall submit written statements from suppliers confirming the orders and stating promised delivery dates.

1.6 INTENT OF DOCUMENTS -**Regardless of hierarchy listed in reference paragraph, in cases of conflict as to the type or quality of materials to be supplied, the Specifications shall govern.**

1.7 FIELD MEASURE

- A. Contractor shall take all necessary field measurements prior to fabrication and installation of work and shall assume complete responsibility for accuracy of same.

1.8 INITIAL SUBMITTAL REQUIREMENT

- A. Contractor shall provide items noted including - bonds, insurance, emergency telephone numbers, progress scheduling, schedules of submittals, subcontractor listings, and the like prior to the start of any work.
- B. Schedule of Values
 - 1. Submit schedule on AIA Form G703
 - 2. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement or as established in Notice to Proceed, whichever is earliest.
- C. Payment Requisitions
 - 1. Submit 1 copy of each application on AIA Form G702 and G703 AND 1 copy on County Voucher Format (format will be provided to GC).
 - 2. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
 - 3. Payment Period: Monthly.

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1.9 SCHEDULES

A. General

1. The objective of this project is to complete the work in the shortest period of time and to protect the building and occupants from damages caused by construction activity during the progress of the work.
2. To meet these objectives, the Contractor shall plan the work, obtain materials, and equipment (not limited to hoists, scaffolding, lifts, etc.), and execute the construction on the most expeditious manner possible and in accordance with the requirements listed below.
3. If the Contractor fails to expedite and pursue any part of the work, the Owner may terminate the contract or may carry out the work as per applicable Article in the General Conditions.
4. The Contractor shall work in coordination with work of other Contractors and with activities with special attention to noise, dust, safety and other contract requirements for work in and around the occupied building.

B. Work Periods and Milestones

Submittals – Post Bid and Technical	Within seven (7) days of receipt of Notice to Proceed or Award
Construction Start	Within 15 days after receipt of Notice to Proceed (NTP)
Substantial Completion	540 days from NTP

1.10 ADDITIONAL WORK

- A. If it appears that some of the work cannot be completed by the scheduled date, the Contractor shall increase the work force or increase the hours of work, including evenings and weekends or necessary, at no additional cost to the Owner. If the work is complete but the area is not cleaned and debris or equipment is not removed, the Owner shall have the right to prepare the area for occupancy with his own forces and deduct the costs from the Contract Amount.
- B. If the Contractor fails to staff the job adequately to meet the completion date, the Owner reserves the right to assume possession of the material and complete installation with the Owner's forces or other Contractors or to require the Contractor to work evenings and weekends.
- C. The Contractor is responsible for temporary protection of all work until acceptance.

1.11 MOLD AND DUST MITIGATION REQUIREMENTS

1. Should the buildings' HVAC systems be in operation during construction, Contractor shall install HEPA or other appropriate filters on air intake louvers to prevent dust and

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fume intake into the system and to prevent spreading dust to adjacent offices and/or public.

2. Contractor shall install appropriate netting, tarps, polyethylene sheets or the like, as required to catch debris from demo operations and to prevent spreading dust.

1.12 WASTE MANAGEMENT PROCEDURES AND DEFINITIONS

A. Waste Management Coordination: Coordinate recycling of materials with Owner and as required to conform to the Construction Waste Management Plan defined in Section 01 74 19.

B. Contractor shall conduct Construction Waste Management meetings. At a minimum, waste management goals and issues shall be discussed at the following meetings:

1. Pre-bid meeting
2. Pre-construction meeting
3. Regular job-site meetings
4. Job safety meetings

C. Waste Management Definitions

1. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like
2. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations
3. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitability, corrosivity, toxicity or reactivity
4. Non hazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitability, corrosivity, toxicity, or reactivity
5. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure
6. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others
7. Recycle: To remove a waste material from the Project site to another site for remanufacture into a new product for reuse by others
8. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste
9. Return: To give back reusable items or unused products to vendors for credit
10. Reuse: To reuse a construction waste material in some manner on the Project site
11. Salvage: To remove a waste material from the Project site to another site for resale or reuse by others
12. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water
13. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste

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14. Toxic: Poisonous to humans either immediately or after a long period of exposure
15. Trash: Any product or material unable to be reused, returned, recycled, or salvaged
16. Volatile Organic Compounds (VOCs): Chemical compounds common in and emitted by many building products over time throughout gassing including -solvents in paints and other coatings; wood preservatives; strippers and household cleaners; adhesives in particleboard, fiberboard, and some plywoods; and foam insulation.
17. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material
18. Waste Management Plan: A Project-related plan for the collection, transportation, and disposal of the waste generated at the construction site. The purpose of the plan is to ultimately reduce the amount of material being landfilled.

END OF SECTION

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DIVISION 1-GENERAL REQUIREMENTS

SECTION 012500 – PRODUCT OPTIONS AND SUBSTITUTIONS (Coordinate with Article 29 of the General Clauses)

1.1 GENERAL

- A. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.2 REQUIREMENTS INCLUDED

- A. Approved Equal Clause
- B. Options
- C. Contractor's Representation
- D. Reimbursements

1.3 APPROVED EQUAL CLAUSE

- A. Throughout the Specifications, types of material may be specified by manufacturer's name and catalog number in order to establish standards of quality and performance and not for the purpose of limiting competition.

Inclusion by name, of more than one manufacturer or fabricator, does NOT necessarily imply acceptability of standard products of those named. All manufacturers, named or proposed, shall conform, with modification as necessary, to criteria established by Contract Documents for performance, efficiency, materials and special accessories.

- B. Contractor may assume the phrase "or approved equal" except that the burden is upon the Contractor to prove such equality and to satisfy Architect that proposed substitute is equal to, or superior to, the item specified.

However, in the event three (3) or more manufacturers are nominated within the technical specifications for a particular item, it shall be assumed that they have been predetermined as equal to each other and that the Contractor must furnish and install materials, equipment or apparatus of one of these so named. CONSERVATION: Coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.4 SUBSTITUTION REQUESTS

- A. If the Contractor elects to prove such equality, he must request the Architect's and the Owner's approval in writing for substitution of such items for the specified items, stating the differences involved with and submitting supporting data and samples, if required, to permit a fair evaluation of the proposed substitution with respect to:
 - 1. Performance
 - 2. Capacity
 - 3. Delivery times and effect on schedules, if any

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4. Changes in space requirements or effect on other elements of work (if applicable)
5. Efficiency
6. Safety
7. Function
8. Appearance
9. Quality and durability
10. Any required license fees or royalties
11. Availability of maintenance service, and source of replacement materials
12. Warranty terms and conditions
13. Cost data comparing the proposed substitution with the product specified

The contractor shall submit a separate request for each product, supported with complete data, with drawings and samples as are appropriate to substantiate the above.

- B. The Architect will review requests for substitutions with reasonable promptness, and notify the Contractor, in writing, of the decision to accept or reject the requested substitution.

1.5 OPTIONS

- A. Where Technical Specifications permit Contractor to select optional materials, items, systems, or equipment, the selection of such options is subject to the following conditions.
 1. Once an option has been selected and approved, it shall be used for the entire contract.
 2. The Contractor shall coordinate his selection with the drawings and specifications and make all necessary adjustments without additional cost to the Owner.

1.6 CONTRACTOR'S REPRESENTATION

- A. A request for a substitution constitutes a representation that the Contractor:
 1. Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.
 2. Will provide the same warranties or bonds for the substitution as for the product specified.
 3. Will coordinate the installation of an accepted substitution in the work, and make such other changes in the work as maybe required for installation to make the work complete in all respects.
 4. Will waive all claims for additional costs, under its responsibility, which may subsequently become apparent.
 5. **Will have coordinated installation with all affected trade contractors, specialty contractors and the like and will be responsible for any and all costs which may arise as a result of this substitution.**
 6. Changes in work of other trades, such as structural supports, which are required as a result of substitution and the associated costs for such changes shall be the complete responsibility of Contractor proposing substitution (there shall be NO additional expense to the Owner).

END OF SECTION 012500

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SUBSTITUTION REQUEST FORM

To: _____ Project: _____

Section	Page	Paragraph	Specified Item

THE UNDERSIGNED REQUESTS CONSIDERATION OF THE FOLLOWING SUBSTITUTION: Attached data shall include, in a tabular format to provide a line by line comparison -product description, specifications, drawings, photographs, performance and laboratory tests and the like with applicable portions of said data clearly identified.

FURTHER, The Proposed Substitution WILL (OR WILL NOT) Affect:

- Dimensions indicated on the drawings? _____
- Wiring, piping, ductwork, or other building services indicated on the drawings? _____
- Other trades and abutting or interconnection work? _____
- Manufacturer's guarantees and warranties? _____
- The construction schedule? _____
- Maintenance and service parts locally available? _____

(NOTE -If Substitution WILL affect any item above, explain in detail.)

In addition to the above, the undersigned agrees to pay for

- 1 Any and all changes to the building design, including structural, civil or electro/mechanical systems engineering (if any), detailing; and
- 2 Any and all additional construction costs caused by the requested substitution.

The undersigned further states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Section	Page	Paragraph	Specified Item
SUBMITTED:		DESIGN PROFESSIONAL'S COMMENTS	
By:		Accepted	Accepted as Noted
Firm:		Not Accepted	Received Too Late
Address:			
			By:
Date:			Date:

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SECTION 013113 – PROJECT COORDINATION

1.1 GENERAL

- A. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.2 REQUIREMENTS INCLUDED

- A. Coordination of Work
- B. Trade Contractor Obligations

1.3 COORDINATION OF WORK

- A. As required by the General Conditions, and restated herein, each Trade and/or Specialty Contractor or Subcontractor shall compare the architectural, structural, civil/site, mechanical, plumbing, and electrical Drawings and Specifications with those for all other trades and shall report any discrepancies between them to the Architect, through the General Contractor, and obtain from him written instructions for changes necessary to the work.

All work shall be installed in cooperation with other trades installing interrelated work.

Before installation, each Trade Contractor shall make proper provisions to avoid interference in a manner approved by the Architect.

All changes required in the work caused by neglect to so advise the Architect shall be made by the offending Contractor at his own expense.

- B. Each Trade Contractor shall be responsible for exact location of anchor bolts, sleeves, inserts, supports, chases, conduits and openings that may be required for the work.

Each Trade Contractor shall prepare layout drawings for incorporation of items to be built-in the work, pass through the work and the like in sufficient time so as not to cause any undue delay in the execution of the work.

Built-in items shall be furnished under the same Section of the Specifications as the respective items to be supported, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located.

Chases, conduits and openings shall be laid out in advance to permit provision in work.

Sleeves and inserts shall not be used in any portion of the building, where their use would impair strength or construction features of the building.

Extra work required where anchor bolts, supports, sleeves, chase openings, conduits or inserts

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have been omitted or improperly placed shall be performed at expense of trade which made error or omission.

- C. Slots, chases, openings and recesses through roof as specified will be provided for the various trades in their respective materials under general construction work, but the trade requiring them shall see that they are properly located and shall do any cutting and patching caused by the neglect to do so.
- D. Locations of pipes, ducts, electrical raceways, switches, panels, equipment, fixtures, etc. shall be adjusted to accommodate the worktop interferences anticipated and encountered.

Each Trade Contractor shall determine, and submit for approval, the exact route and location of each pipe, duct and electrical raceway prior to fabrication.

Approval by the Architect is required prior to any such modifications.

- E. The General Contractor shall provide temporary weather tight and protected openings in structure to facilitate placement of equipment.

1.4 TRADE CONTRACTOR OBLIGATIONS

- A. The Trade Contractors are required to supply all necessary supervision and coordination information to any other trades who are supplying work to accommodate the electrical and mechanical installations.
- B. Where a trade is required to install items which it does not purchase, it shall include for such items:
 - 1. The coordination of their delivery
 - 2. Their unloading from delivery trucks driven in to any designated point on the property line at grade level
 - 3. Their safe handling and field storage up to the time of permanent placement in the project
 - 4. The correction of any damage, defacement or corrosion to which they may have been subjected
 - 5. Their field assembly and internal connection as may be necessary for their proper operation
 - 6. Their mounting in place including the purchases and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions unless support members are shown on structural or architectural drawings
 - 7. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems
- C. Items which are to be installed but not purchased as part of the work of a particular trade shall be carefully examined by this trade upon delivery to the project.

Claims that any of these have been received in such condition that their installation will require procedures beyond the reasonable scope of the work of the installing trade will be considered only if presented in writing within one week of the date of delivery of the items in question.

The work of the installing trade shall include all procedures, regardless of how extensive,

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necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

END OF SECTION 013113

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SECTION 013300 – SUBMITTAL REQUIREMENTS

1.1 GENERAL

- A. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.
- B. Submittals shall be made in groupings where installations are complimentary, i.e. porcelain tile, grout, metal studs, gypsum board; etc. Failure to comply with this requirement will be cause for rejection of any or all submittals.

1.2 REQUIREMENTS INCLUDED

- A. Approved Equal Clause/Substitutions/Options
- B. Certification
- C. Manufacturer's Instructions
- D. Shop Drawings
- E. Samples
- F. Material Safety Data Sheet (MSDS) Submittals
- G. Scheduling of Submittals
- J. Progress Photographs
- K. Certificates
- L. Construction Waste Management Procedures and Certifications – See Section 01 74 19.
- M. V.O.C. Compliance certification – See individual technical sections.

1.3 APPROVED EQUAL CLAUSE/SUBSTITUTIONS/OPTIONS -Section 01 25 00

1.4 CERTIFICATION

- A. Certification of compliance with specification performance standards and manufacturers' specifications and directions shall be furnished for any portion of this work for which specific performance requirements and/or manufacturers' specifications are listed.

It shall be the responsibility of the Contractor to secure two (2) copies of each certification when required and transmit same to the Architect.

- B. Sample Certification Form (2 pages) is attached as an exhibit at the close of this Section. Each item requiring certification shall be so noted and affidavits shall be filed singly to cover each specified material, installation, application and the like.

CERTIFICATIONS SHALL BE SUBMITTED AS PART OF THE CLOSE OUT DOCUMENT REQUIREMENTS SET FORTH IN SECTION 01 77 00.

1.5 MANUFACTURERS' INSTRUCTIONS

- A. Where in these specifications an item is called for to be installed in accordance with the manufacturer's directions, specifications or recommendations, the Contractor shall furnish the Architect with two (2) printed copies of said directions, specifications or recommendations,

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before the item is installed.

1.6 SHOP DRAWINGS

- A. The following serves as a further definition of the requirements for shop drawing submittals as covered in Article 44 of the General Clauses:
1. The Contractor shall submit to the Architect with such promptness as to cause no delay in the work, layout, detail, schedule, setting, product data and shop drawings for each part of the work as specified or required.
 2. BEFORE SUBMITTING ANY DATA FOR APPROVAL, THE CONTRACTOR SHALL CHECK THE SUBMITTALS OF ALL SUBCONTRACTORS FOR ACCURACY AND CONTRACT COMPLIANCE.

Contractor shall see that all work contiguous with and having bearing on work indicated on drawings is accurately and distinctly illustrated and that work shown is in conformity with contract requirements.

3. Shop drawings shall be numbered consecutively and shall represent:
 - a. All working and erection dimensions.
 - b. Arrangement and sectional views.
 - c. Necessary details, including information for making connections to other work.
 - d. Kinds of materials and finishes. Colors, where applicable.
4. Shop drawings shall be dated, and shall generally contain:
 - a. Name and Number of project.
 - b. Name, address and telephone number of submitting Contractor.
 - c. Description of required equipment, materials, and classification item numbers.
 - d. Locations at which materials or equipment are to be installed in the Work.
 - e. Identification of drawings, schedules, notes and/or details and specification sections and related paragraphs to which they apply.
 - f. Equipment or fixture identification corresponding to that used in Contract Documents.
 - g. Accessories and special or non-standard features and materials which are being furnished.
 - h. Properly marked with external connection identification as related to the project where they consist of standard factory assembly or field installation drawings.

In addition to the general data required above, applicable mechanical and electrical submissions shall contain:

- a. Manufacturer's specifications including materials of construction, metal gauge, thickness and finish.
- b. Certified dimensional drawings including clearances required for maintenance or access (coordinate with Section 01 31 14)
- c. Performance data, ratings, operating characteristics, and operating limits.
- d. Electrical ratings and characteristics.
- e. Wiring and control diagrams, where applicable.
- f. Certifications requested, including UL label or listing.
- g. List of accessories which are required but are NOT being provided by the product manufacturer or are NOT being furnished under this Section.

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Identify the Section(s) under which the accessories are being furnished.

5. Submission of data for approval shall be accompanied by letter of transmittal, in duplicate, containing the name of the project, Contractor's name, number of drawings, titles and other pertinent data.

6. Procedure for Submitting Shop Drawings and Product Data:

The contractor shall submit five (5) copies of data, for standard manufactured items, in the form of manufacturer's catalog sheets, showing illustrated cuts of the items to be furnished, scaled details, sizes, dimensions, performance characteristics, operating clearances, capacities, wiring diagrams and all other pertinent information.

NOTE - all such data shall have "review" stamp applied to each submittal prior to submittal.

Two copies of reviewed submissions will be returned to the contractor.

The average "turn around time" of any one in-house submittal by the Architect shall not exceed 15 business days for review and at least 20 business days when another consultant is involved.

- a. For drawings returned "Resubmit", "Amend & Resubmit", "disapproved", or "Rejected-Resubmit", the original drawings shall be corrected and resubmitted, without any additional charges to the Owner, until final approval.
- b. For drawings returned "Approved", "No Exceptions Taken", "approved as Noted", and "Make Corrections Noted", the contractor shall obtain and provide sufficient prints as required for the field.

NOTE: It is the responsibility of the contractor to confirm all dimensions, quantities, and the coordination of materials, systems and products supplied by him with other trades. Approval of shop drawings containing errors does not relieve the contractor from making corrections at his expense.

7. No work as called for by shop drawings shall be done until Architect's approval.
8. IF SUBMITTALS SHOW VARIATIONS FROM CONTRACT REQUIREMENTS BECAUSE OF STANDARD SHOP PRACTICES, OR OTHER REASONS, CONTRACTOR SHALL MAKE SPECIFIC MENTION OF SUCH VARIATION IN HIS LETTER OF TRANSMITTAL.
9. APPROVAL OF SHOP DRAWINGS IS GENERAL. IT SHALL NOT RELIEVE CONTRACTOR OF THE RESPONSIBILITY FOR ACCURACY OF SUCH DRAWINGS, NOR FOR THE FURNISHING OF MATERIALS OR PROVISION OF WORK REQUIRED BY THE CONTRACT AND NOT SHOWN ON THE SHOP DRAWINGS.

Unless it is an interpretation of design intent, approval of shop drawings shall not be construed as approval of departures from Contract.

10. If the Contractor should alter any information on previous submittals, besides the notations called for by the Architect, he must circle this new information to bring it to

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the Architect's attention.

11. In submitting data for approval, all associated drawings, product data and the like, relating to a complete assembly shall be submitted at one and the same time so that each may be checked in relation to the entire proposed assembly.

PARTIAL SUBMISSIONS WILL BE RETURNED WITHOUT ACTION TAKEN.

12. Contractor shall have copies of all approved shop drawings as listed in Paragraph 1.6.A.6 above on the job at all time and shall make them available to the Architect or the Owner's representatives.

1.7 SAMPLES

A. The following serves as a further definition of the requirements for sample submittals as covered in Article 44 of the General Clauses:

1. Names of proposed manufacturers, materials men and dealers who are to furnish materials, fixtures, appliances or other fittings shall, where practical, be submitted to the Architect for early approval to afford proper investigation and check.
2. No manufacturer will be approved for any materials to be furnished under this contract unless he shall be of good reputation and shall have plant of ample capacity and shall have successfully produced similar products.
3. All transactions with manufacturers and subcontractors shall be through the Contractor.
4. Unless otherwise specified, samples shall be in duplicate (2) and of adequate size to show quality, type, color, range, finish, texture, etc.

INTERRELATED COLOR SELECTIONS WILL NOT BE MADE UNTIL ALL PERTINENT SAMPLES ARE MADE AVAILABLE TO ARCHITECT.

Deliver one (1) sample to field office and one (1) sample to Architect's office unless otherwise directed.

5. Each sample shall be labeled, bearing material and quality names, submitting Contractor's name, and project name, and other pertinent data.

In accordance with OSHA regulation Number 1910.1200, a Manufacturers Material Safety Data Sheet (MSDS) shall be submitted for each product to be incorporated in the work.

Failure to observe these submittal requirements will be cause for rejection of the entire submittal.

The safe handling of products by the applicator according to MSDS warnings is a safety issue, like any other, entirely within the purview of the General Contractor.

6. Where Specifications require manufacturer's printed installation directions, such directions and diagrams shall accompany samples. Coordinate with Paragraph 1.05 herein.

7. A duplicate letter of transmittal from the submitting Contractor requesting approval

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of the sample shall accompany the samples.

8. Transportation charges to designated locations must be prepaid on all samples.

9. Materials shall not be ordered until approval is received in writing from the Architect.

All materials shall be furnished equal in all respects to the samples which were approved.

1.8 MATERIAL SAFETY DATA SHEET (MSDS) SUBMITTALS

A. As specified in Paragraph 1.7 of this Section and within the technical sections forming this Specification, the Contractor is directed to the following requirements concerning "MSDS" submittals:

1. Submit MSDS's for all products used during construction whether incorporated within the work or used in the performance of the work.
2. Identify which products may be harmful to construction workers or other building occupants.
3. Develop means and methods for protection of construction workers and other building occupants from potentially harmful products. **Submit said means and methods to the Owner for review and approval.**

B. Further, the General Contractor with assistance from each individual contractor shall maintain a "MSDS" file on site, accessible to workers and otherwise in compliance with jurisdiction's "Right To Know" legislation.

C. **Attention is directed Section 01 77 00, Article 1.4.A.12 for final closeout submittal of MSDS compilation to the Owner.**

1.9 SCHEDULING OF SUBMITTALS

A. Within two (2) weeks after execution of the Contract, the Contractor shall submit a detailed listing of all items to be incorporated within the work, including all items of mechanical and electrical, as applicable.

Listing should state the following:

1. Date of shop drawing/sample submittals.
2. Guaranteed delivery date after shop drawing and/or sample approvals.
3. Date of installation start.
4. Date of installation completion.

1.10 PROGRESS PHOTOS

A. This Article includes requirements for periodic construction photography by the General Contractor, utilizing digital camera equipment, to demonstrate construction progress and to serve as a communicative device when describing a given condition to others at a remote location, by means of the internet.

B. Photography shall be taken using a digital camera and electronic program which will download the digital photos in a JPEG format to a computer with resolution adequate to demonstrate the item under discussion.

C. One set of record prints will be required and filed with the monthly requisition. The JPEG files shall be transmitted to the appropriate parties who shall then have the option to view

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the picture(s) on screen or print them out using their own equipment.

- D. It is the intention of this Section to provide a tool to enhance communications and reduce the amount of time required to address questions arising at the Project site. In this end, the Contractor shall utilize good judgment in providing photographs that are informative, and not merely repeating what is shown in the other photographs.
- E. Provide factual representation of construction extent and conditions. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion, utilizing a normal lens.
- F. Before starting work, the Contractor shall take photographs of the site from different points of view sufficient in number to show all present conditions.
- G. The minimum requirements, per requisition period are six (6) photographs of each of the Building units, and three (3) photographs of the Site Work, from different points of view designated by the Architect.

1.11 CERTIFICATES

- A. Submit a Summary of Solid Wastes Generated, manifests, weight tickets, and the like in accordance with requirements of Section 017419 -Construction Waste Management.
- B. Submit, as required by each technical section a certification for V.O.C. compliance.

END OF SECTION 013300

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SECTION 013513 – SPECIAL REQUIREMENTS

1.1 GENERAL

A. Attention is directed to the Information For Bidders and the General Clauses and all Sections within Division 1 - General Requirements which are hereby made a part of this Section of the Specifications.

B. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.2 DESCRIPTION OF REQUIREMENTS

A. Supplementary Definitions

B. Field Engineering – Coordinate with Section 01 71 23.

C. Reference Standards and Applicable Laws and Permits.

D. Protection of property and the public. Coordinate with Article 13, 14 and 20 of the General Clauses.

E. Noise Control. Coordinate with Article 45 of the General Clauses and Section 01 15 00.

F. Utility Shutdowns.

1.3 SUPPLEMENTARY DEFINITIONS - Supplement Article 2 of the General Clauses.

A. PROVIDE: The Term "provide" shall mean "furnish and install complete and ready for safe and regular use and/or operation of the item, material or service indicated".

B. INDICATED AND SHOWN: Shall mean as detailed, scheduled, or called for in the Contract Documents.

C. The terms "KNOWLEDGE," "RECOGNIZE" and "DISCOVER," their respective derivatives and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows (or should know), recognizes (or should recognize) and discovers (or should discover) in exercising the care, skill, and diligence required by the Contract Documents. Analogously, the expression "reasonably inferable" and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a contractor familiar with the Project and exercising the care, skill and diligence required of the Contractor by the Contract Documents.

D. The phrase "PERSISTENTLY FAILS" and other similar expressions, as used in reference to the Contractor, shall be interpreted to mean any combination of acts and omissions, which causes the County's Architect/Engineer to reasonably conclude that the Contractor will not complete the Work within the Contract Time, for the Contract Sum or in substantial compliance with the requirements of the Contract Documents.

E. Words in the singular shall also mean and include the plural, wherever the context so indicates, and words in the plural shall mean the singular, wherever the context so indicates.

F. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.

G. The term "Furnish" shall mean "to fit out and/or supply" material required for project use.

H. The term "INSTALL" shall mean "set", "connect", "erect", "apply" or to "otherwise fix into position for use".

I. Whenever the terms "material" or "materials" are used in the specifications, they shall mean any "product", "equipment", "device".

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- J. The terms "approved" or "approval" shall mean the written approval of the Architect/Engineer.
- K. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect/Engineer; the terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect/Engineer; and the terms "necessary", "responsible", "proper", "correct" and similar words shall mean necessary, reasonable, proper, or correct, in the judgment of the Architect/Engineer.
- L. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceiling, embedded in construction or in crawl spaces.
- M. "Exposed" means not installed underground or "concealed" as defined above as well as work visible to building occupants.
- N. "Invert Elevations" means the inside bottom of pipe.
- O. "The Contractor" or "Contractor" meaning that Contractor normally responsible for that work referenced;
 - 1. The term "Specialist" or "Specialty Contractor" as used in these specifications shall mean an individual or firm of established reputation, or, if newly organized, whose personnel have previously established a reputation in the same field, which is regularly engaged in, and which maintains a regular force of workmen skilled in either manufacturing or fabricating items required by the Contract, installing items required by the Contract, or otherwise performing work required by the Contract.
 - 2. Where the Contract Specifications require installation by a "Specialist", that term shall also be deemed to mean either the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform such work under the manufacturer's direct supervision.

1.4 FIELD ENGINEERING

- A. Provide field engineering services; establish grades, lines and levels, by use of recognized engineering survey practices, as applicable.

1.5 REFERENCE STANDARDS AND APPLICABLE LAWS AND PERMITS –
Coordinate with Information for Bidders and the General Clauses.

- A. All materials and work provided under this contract shall be in accordance with all applicable federal, state and local laws, regulations, ordinances, codes, standards and orders, and the contractor shall be responsible for all documents, applications, plans, etc. and payment of all fees to secure all required permits and approvals to complete the work in accordance with all requirements of this contract.
- B. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes or within these Contract Documents.
- C. The date of the standard is that in effect as of the Advertisement date, except when a specific date is specified.
- D. Obtain copies of standards when required by Contract Documents. Maintain copy at jobsite during progress of the specific work.
- E. Where specific performance requirements are listed herein, it is the intent of this specification that all manufacturers, fabricators, suppliers, installers, contractors, subcontractors, specialty and sub-subcontractors will provide services satisfying these requirements whether mentioned by trade or manufacturers name or submitted for approval as an approved or equal.

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- F. Where no explicit quality or standards for materials or workmanship are established for work, such work shall be of such quality consistent with industry standards and of the construction quality established for the Project generally.

1.6 PROTECTION OF PROPERTY AND THE PUBLIC; USE OF PREMISES

- A. The Contractor shall provide adequate means for the purpose of preventing dust caused by construction operations throughout the period of the construction contract.
- B. This provision does not supersede any specific requirements for methods of construction or applicable conditions set forth in the General and General Clauses with added regard to performance obligations of the General Contractor.
- C. The General Contractor shall take steps to prevent the introduction of pollutants and dust into the ventilation system during construction.

1.7 NOISE CONTROL - Coordinate with Section 01 15 00, Most Restrictive Provisions Apply.

- A. Develop and maintain a noise abatement program and enforce strict discipline over all personnel to keep noise to a minimum.
- B. Execute construction work by methods and by use of equipment which will reduce excess noise.
- C. Equip air compressors with silencers, and power equipment with mufflers.
- D. Manage scheduling to reduce noise.

1.8 UTILITY SHUTDOWNS

- A. When installation of a partial or a complete new system or modifications to an existing system requires shutdown of an operating system, the connection of the partial system shall be performed only after prior notification of the estimated shutdown time periods have been approved by the Owner and the Architect/Engineer and then only in the following time periods.

Advance Notification Time Required:

- Fire Alarm Shunts – 7 days
- Electrical and/or Plumbing shutdowns – 2 weeks

- B. The Contractor shall do all work involved in shutdown period when scheduled and/or directed by the Architect/Engineer and at no additional expense to County.

- C. Certain service "cut-in" may require overtime operations which will be accomplished at no extra cost to County.

1.9 ADDITIONAL INSURANCE REQUIREMENTS – (ONLY FOR PROJECTS THAT INCLUDE ASBESTOS ABATEMENT WORK)

- A. . See GENERAL REQUIREMENTS- Additional Insurance Requirements – page 1.5

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1.10 SPECIAL PROVISIONS FOR CONSTRUCTION

- A. Work Times: Monday to Friday between 8:00 am and 4:00 pm.
- B. Contractors are to use area designated for dumpsters and staging as approved by the Owner. Contractor's storage of materials to be in secure containers.
- C. There will be contractor parking on site.
- D. There will be Contractor Criminal background checks as per Executive order 1-2009-8.

END OF SECTION 013513

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SECTION 013529 HEALTH AND SAFETY PLAN

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.2 REQUIREMENTS INCLUDE

- A. Provide all labor, equipment and materials and perform all operations in connection with monitoring air quality, decontaminating equipment and providing worker health and safety protection for all Contractor and Subcontractor personnel.
- B. Develop a site specific Health and Safety Plan (HASP) specifically addressing the potential hazards that may be encountered. This plan shall meet all Occupational Safety and Health Administration (OSHA) requirements.
- C. Review the requirements and data presented and supplement the program with any additional measures deemed necessary to fully comply with regulatory requirements and adequately protect personnel on the site.

1.3 REFERENCES

- A. OSHA Regulation 29 CFR 1910.120.
- B. OSHA Regulation 29 CFR 1926.62.

1.4 DEFINITIONS

- A. Site Safety Official (SSO): The individual who is responsible to the Contractor and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements

1.5 SUBMITTALS

- A. Provide within seven (7) days after execution of the Agreement.
 - 1. Site-specific HASP including the Emergency Response Plan to the Owner, Owner's Representative and Architect for review, including provisions for decontamination and a contingency plan for unforeseen emergencies. The review is only to determine if the HASP meets basic regulatory requirements and the minimum requirements of this Section. The review will not determine the adequacy of the HASP to address all potential hazards, as that remains the sole responsibility of the Contractor
 - 2. Current certification of employee's health and safety training and certification of employee's baseline medical exam status
 - 3. Certification of additional required health and safety training for Supervisors
 - 4. Qualifications and experience of the SSO for approval
- B. Submit minutes of weekly safety meetings at periodic progress meetings.

1.6 CONTRACTORS RESPONSIBILITIES

- A. Contractor is solely responsible for the health and safety of workers employed by the Contractor,

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any Subcontractor and anyone directly or indirectly employed by any of them

- B. Develop and follow a site specific Health and Safety Plan (HASP) in accordance with the requirements of paragraph 1.7
- C. Provide a full-time SSO regardless of whether or not the Work is at a defined Uncontrolled Hazardous Waste Site.
- D. Pre-arrange emergency medical care services at a nearby hospital, including establishment of emergency routes of travel.
- E. Meetings:
 - 1. Conduct daily job briefings with all site personnel to discuss relevant health and safety issues including but not limited to hazards, monitoring, procedures and controls. Document attendance and topics covered.
 - 2. At a minimum, conduct weekly safety meetings with all site personnel, documenting attendance and topics covered.

1.7 HEALTH AND SAFETY PLAN (HASP) REQUIREMENTS

- A. Temporary overhead protection for interior of building:
 - 1. safety and health hazard assessment
 - 2. procedures for emergency medical treatment and first aid
 - 3. map indicating route to hospital for emergency medical care
 - 4. physical hazard evaluation
 - a. equipment operation
 - b. confined space entry
 - c. slips and falls
 - d. falling debris
 - e. encountering unmarked utilities
 - f. cold and heat stress
 - g. hot work (cutting and welding)
 - 5. Training requirements
 - 6. Recordkeeping requirements

END OF SECTION

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SECTION 015000 – TEMPORARY FACILITIES

(Coordinate with Article 46 and 48 of the General Clauses)

1.1 GENERAL

- A. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.
- B. Temporary facilities indicated to be provided by a Contractor for the use of his Subcontractors and/or other Contractors shall mean for their use without payment for such use unless otherwise specified.

1.2 REQUIREMENTS INCLUDED

- A. Temporary and Permanent Services, General
- B. Temporary Light and Power
- C. Temporary Heating/Cooling Facilities
- D. Temporary Toilet Facilities
- E. Temporary Water
- F. Storage Facilities
- G. Scaffolding and Staging
- H. Roof Protection
- I. Temporary Use of Permanent Elevator as Equipment Material Hoist
- J. Rubbish Container
- K. Construction Fencing
- L. Janitorial Service/Daily Cleanup
- M. Fire Prevention Control
- N. Temporary Fire Protection
- O. Discontinuance, Changes and Removal

1.3 TEMPORARY SERVICES, GENERAL

- A. The Contractor shall provide and maintain, either directly or through its' subcontractors, all temporary services and utilities, including all labor, materials, equipment and the like necessary to adequately furnish, deliver and maintain said services at all times when required during the term of the Contract.

NOTE: In accordance with OSHA and other applicable regulations, the respective Contractors performing work are solely responsible for the netting, guard rail protection and such other safety devices as deemed necessary to protect the workers and public from harm.

1.4 TEMPORARY LIGHT AND POWER

- A. The Contractor shall
 - 1. Provide all required temporary electric facilities as required for this project from Owner supplied service as outlined below.
 - 2. Insure that all temporary electrical work shall be in conformity with the National Electric Code and in accordance with applicable governmental regulations.
 - 3. Whenever possible Contractor shall MAINTAIN AND SERVICE THE TEMPORARY ELECTRIC SYSTEM. The energy will be supplied, and paid for, by the Owner for all work. No reimbursement will be made by Owner in the event of disconnect.

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- B. The Contractor shall provide and maintain
 - 1. A feeder network of sufficient size and capacity for all requirements of construction, except welding and shall maintain same while under construction and until the permanent feeders and related equipment have been installed and are in operation.
 - 2. Equip each branch circuit with lamp sockets and fused grounding type outlets for 120 and 208, 240 volt, single phase power. Provide lamp sockets of weatherproof medium base type. The power outlets shall consist of an approved box with cover containing fuse holders and grounding type outlets, Buss Type SRX and SKY.
 - 3. Fuse cutout bases for each branch circuit. The total load on each branch circuit (light and power) shall not exceed twenty (20) amperes.
 - 4. All lamps and fuses (including replacements for temporary lighting and power). Provide 13 watt LED or equivalent lamp for each lighting outlet.
 - 5. All equipment requiring other than 120 v/ 60 cycle/ single phase operation, as well as welders, shall be run under portable generators or from step-up transformers furnished by the trades requiring same.
 - 6. Provide all wiring and equipment for temporary lighting and power so that service shall be available to the work.
 - 7. Provide temporary light based on a minimum of 1 watt per square foot covering each and every square foot of roof area. For work on roof, provide adequate outdoor lighting to illuminate hazards and to satisfy minimum requirements of safety and security, subject to Architect's and Owner's approval.
 - 8. Upon completion of all work and or when directed by the Architect, remove all temporary wiring and ancillary work.
 - 9. Temporary light and power will be made available during all hours of operation of Contractor without additional costs to the owner.

- 1.5 TEMPORARY HEATING/COOLING FACILITIES – where applicable by Contractor
 - A. The Contractor shall provide and pay for all temporary heating, coverings and enclosures necessary to properly protect all work and materials against damage by dampness and cold, to dry out the work and to facilitate the completion thereof. The Contractor shall maintain the critical installation temperatures, provided in the technical provisions of the specifications, herein, for all work in those areas where same is being performed.
 - B. The maintenance of proper heating, ventilation and adequate drying out of the work is the responsibility of the Contractor and any work damaged by dampness, insufficient or abnormal heating shall be replaced to the satisfaction of the Architect by and at the sole expense of the Contractor.
 - C. Unless otherwise specified, the minimum temperature shall be 50 degrees F at all places where work is actually being performed within the enclosed Project.

- 1.6 TEMPORARY TOILET FACILITIES – where applicable by Contractor
 - A. All maintenance and restoration of facilities is the responsibility of the General Contractor upon completion at no cost to the Owner.

- 1.7 TEMPORARY WATER – where applicable by Contractor
 - A. The Owner will provide water service to the Contractor without charge, but reserves the right to terminate, without incurring additional cost, said service in the event of abuse of such service.
 - B. The Contractor shall make all necessary connections and extend piping to areas required at no additional cost to the Owner.
 - C. The Contractor shall have all equipment for the temporary water removed at the

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completion of the Project or when directed by the Architect or Owner.

1.8 STORAGE

- A. Materials delivered to the site shall be safely stored and adequately protected against loss or damage. Particular care shall be taken to protect and cover materials that are liable to be damaged by the elements.

1.9 SCAFFOLDING AND STAGING

- A. All scaffold, staging and appurtenances thereto shall comply in total to the requirements of Safety and Health Regulations for Construction Chapter XVII of OSHA, Part 1926 and all related amendments.
- B. Shop Drawing Submittals for scaffolding and bridging are required and shall be stamped and signed by a NYS licensed structural engineer.

1.10 ROOF PROTECTION – As Applicable to Scope of Work.

- A. During the construction period, after installation of roofing system specified under Division 7, and notification from Manufacturer as to certified completeness, the Contractor shall take strict precautions against unnecessary traffic on the roofing surface.
- B. The Contractor shall provide temporary protection on the roof surface when it is necessary for work to take place on completed sections.
- C. Upon such notification as required in subparagraph A, the Contractor shall assume responsibility for damages, if any, to the roofing system caused by the work of other trades, except that financial liability for any and all damages rests with the offending trade.

1.11 TEMPORARY USE OF PERMANENT ELEVATOR AS EQUIPMENT MATERIAL HOIST –
As applicable only upon approval by Owner.

1.12 RUBBISH CONTAINER

- A. Provide suitable rubbish container device (s), properly maintained and serviced, replaced as required and protected from access by the public by fencing as may be specified herein or approved by the Architect.
- B. Each Subcontractor shall sweep up and gather together daily all his own rubbish and removed materials and place same in containers to be provided by the Contractor. Wood crates and similar matter shall be broken up, securely tied into bundles and stacked alongside rubbish containers OR in locations as directed by the Contractor. Items larger than container capacity shall be removed from the site by the respective contractor.
- C. THE CONTRACTOR'S ATTENTION IS DIRECTED TO THE REQUIREMENT OF RELOCATION OF THE COMPLETE REMOVAL SYSTEM AT VARIOUS TIMES THROUGHOUT THE PROJECT AS MAY BE REQUIRED TO MAINTAIN PROGRESS OF THE WORK.

1.13 CONSTRUCTION FENCING – Coordinate with Staging/Exiting Drawings as applicable to the particular project.

- A. Construction fencing shall be provided enclosing all work and storage areas or where indicated on the drawings. Unless otherwise shown or directed, all fencing shall be 8 feet high, accurately aligned and plumb, adequately braced, and complete with gates, locks, and hardware as required.

UNDER NO CONDITIONS SHALL FENCING BE ATTACHED OR ANCHORED TO EXISTING CONSTRUCTION OR TREES.

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Fencing shall be as follows:

1. Fencing traversing paved areas shall be free standing sandbagged barrier type in a continuous manner, firmly aligned and securely mounted. Fencing shall essentially consist of heavy timber wood sill with chainlink fencing consisting of 2 inch posts with top and bottom rails of 1 inch pipe and No. 9 wire fabric. All fencing shall be galvanized.
 2. Fencing traversing "grassed areas" shall be chainlink fencing consisting of 2 inch posts with top and bottom rails of 1 inch pipe and No. 9 wire fabric. All fencing shall be galvanized. Posts shall be set below grade a minimum of 2 foot and firmly anchored.
- B. Site access gates shall be provided as required of same material as site fence complete with all operating hardware and security devices.
- C. Contractor shall submit drawings showing type, materials and construction of fencing to Architect for approval before proceeding with installation.
- D. All wood or metal products, unless galvanized, shall receive 2 coats of latex exterior paint of color and manufacturer as approved by the Architect.
- E. Should fencing be required to be relocated during the course of the project, same shall be done at the total expense of the Contractor. At the completion of the project, the Contractor shall remove and dispose of the construction fencing.
- F. The construction fence shall be MAINTAINED IN GOOD ORDER by the Contractor throughout the life of the project.

1.14 JANITORIAL SERVICE/DAILY CLEANUP

- A. The Contractor shall furnish daily janitorial services for the project and perform any required maintenance of facilities as deemed necessary by the Architect during the entire life of the contract. Toilet facilities shall be kept clean and sanitary at all times. Services shall be accomplished to the satisfaction of the Architect. The Contractor shall provide daily trash collection and cleanup of the project area and shall dispose of all discarded debris, and the like in a manner approved by the Architect.

1.15 FIRE PREVENTION CONTROL

- A. All Contractors shall comply with the safety provisions of the National Fire Protection Association's "National Fire Codes" pertaining to the work and, particularly, in connection with any cutting or welding performed as part of the work.

1.16 TEMPORARY FIRE PROTECTION

- A. Each Contractor shall take all possible precautions for the prevention of fires. No flame cutting torches, blow torches, or welding tools shall be used within the building.
- C. No volatile liquids shall be used for cleaning agents or as fuels for motorized equipment or tools within a building.

1.17 DISCONTINUANCE, CHANGES AND REMOVAL

- A. All Contractors shall:
1. Discontinue all temporary services required by the Contract when so directed by the Owner or the Architect.

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The discontinuance of any such temporary service prior to the completion of the work shall not render the Owner liable for any additional cost entailed thereby and each Contractor shall thereafter furnish, at no additional cost to the Owner, any and all temporary service required by such Contractor's work.

2. Remove and relocate such temporary facilities as directed by the Owner or the Architect without additional cost to the Owner, and shall restore the site and the work to a condition satisfactory to the Owner.

END OF SECTION 015000

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SECTION 015719 - ENVIRONMENTAL PROTECTION DURING CONSTRUCTION

1.1 GENERAL

- A. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.2 REQUIREMENTS INCLUDED

- A. Scope
- B. Applicable Regulations
- C. Notification
- D. Implementation
- F. Protection of Water Resources
- G. Burning
- H. Dust and Mud Control

1.3 SCOPE

- A. The work covered by this section consists of furnishing all labor, material and equipment and performing all work required for the prevention of environmental pollution during and as the result of construction operations under this contract except for those measures set forth in other Technical Provisions of these specifications.
- B. Compliance with the provisions of this section by all Subcontractors shall be the responsibility of the Contractor.

1.4 APPLICABLE REGULATIONS

- A. In order to provide for abatement and control of any environmental pollution arising from the construction activities of the Contractor and his subcontractors in the performance of this contract, they shall comply with all applicable Federal, State and local laws, and regulations concerning environmental pollution control and abatement as well as the specific requirements stated elsewhere in the contract specifications.

1.5 NOTIFICATION

- A. The Architect will notify the Contractor in writing of any noncompliance with the foregoing provisions. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Architect may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost on account of any such stop orders shall be made the subject of a claim for extension of time or for extra costs or damages by the Contractor unless it was later determined that the Contractor was in compliance.

1.6 PROTECTION OF WATER RESOURCES

- A. At all times of the year, special measures shall be taken to prevent chemicals, fuels, oils, grease, bituminous materials, waste washings, herbicides and insecticides, and cement and surface drainage from entering public waters.
- B. If any waste material is dumped in unauthorized areas the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed area.

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If necessary, contaminated ground shall be excavated, disposed of as directed by the Architect, refilled with clean material and compacted all at the expense of the Contractor.

1.7 BURNING

A. Burning will not be permitted.

1.8 DUST AND MUD CONTROL

A. The Contractor shall at all times provide adequate dust control measures. He shall accomplish this, without interference to the public/tenants.

END OF SECTION 015719

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SECTION 017123 – FIELD ENGINEERING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specified field engineering services required for the Project, including but not limited to
 - 1. Structural, or other professional engineering services specified, or required to execute Contractor's construction methods
 - 2. All items requiring signed and sealed shop drawings

1.2 REQUIREMENTS INCLUDED

- A. Related Requirements
- B. Qualifications of NYS Licensed Engineer
- C. Submittals

1.3 RELATED REQUIREMENTS

- A. Examine Contract Documents for requirements that affect work on this Section

1.4 QUALIFICATIONS OF ENGINEER

- A. Registered professional engineer of the discipline required for the specific service on the Project, licensed in the state in which the Project is located.

1.5 SUBMITTALS

- A. Submit name and address of professional engineer to Architect.
- B. On request of Architect, submit documentation to verify accuracy of field engineering work not limited to scaffolding, overhead protection, bridges and other methods requiring OSHA approval.
- C. Submit certificate signed by registered engineer certifying that elevation and locations of improvements are in conformance, or non-conformance, with Contract Documents.

END OF SECTION 017123

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DIVISION 1 – GENERAL REQUIREMENTS

SECTION 017700 – PROJECT CLOSE OUT

1.01 GENERAL

- A. All Contractors, Subcontractors, Sub-subcontractors, Vendors and the like shall be required to familiarize themselves with said provisions.

1.02 REQUIREMENTS INCLUDED

- A. Final Cleanup
- B. Required Close Out Documentation
- C. Project Close Out Inspections

1.03 FINAL CLEANUP

- A. The Contractor shall leave the work ready for use and occupancy without the need of further cleaning of any kind.
- B. The Contractor shall remove all tools, appliances, project signs, material and equipment from the phased areas as soon as possible upon completion of the work.
- C. The work is to be turned over to the Owner in new condition, in proper repair and in perfect adjustment.

1.04 REQUIRED CLOSE OUT DOCUMENTATION

- A. Prior to final payment, *and as part of the final requisition*, the Owner shall receive, in addition to those documents required by the General Conditions, the following:
 - 1. Project record documents
 - 2. Coordination drawings
 - 3. The Contractor's general guarantee.
 - 4. Specific guarantees of material, equipment and systems installed in the work.
 - 5. A copy of all test data taken in connection with the work.
 - 6. Three (3) copies of all operation and maintenance manuals which shall include:
 - a. Sequence of Operation and Control Diagrams, corrected for as-built conditions.
 - b. Parts List, including illustrations, assembly drawings and diagrams required for maintenance, predicted life of parts subject to wear, and recommendations for stocking spare parts.
 - c. Copies of accepted shop drawings, charts and diagrams.
 - d. Names, addresses and telephone numbers of manufacturer's representative and service company.
 - e. Letters from each manufacturer certifying that his equipment was properly installed and is operating in accordance with manufacturer's intent.
 - f. MSDS sheets tabulated and indexed as per specification sections.
 - g. Copies of all test reports, including balancing, and with corrections confirmed, must be provided with the contractor's request for a substantial completion inspection.
 - h. An "Underwriter's Certificate" shall be provided in the O&M manuals to be provided to the Owner.
 - 7. Preventative Maintenance Schedule Sheets.
 - 8. Copies of all Certification of Specifications Compliance as per Section 01 33 00.

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9. Record of Manufacturers Material Safety Data Sheets (MSDS).
10. Certified Payroll Records.

1.05 PROJECT CLOSE OUT INSPECTIONS

- A. When the Work has reached such a point of completion that the building or buildings, equipment, apparatus or phase of construction or any part thereof required by the Owner for occupancy or use can be so occupied and used for the purpose intended, the Contractor, prior to notification to the Architect, shall make a preliminary inspection of the Work to insure that all the requirements of the Contract have been met and the Work is substantially complete and is acceptable.

Upon such notification, the Owner or the Architect shall make a detailed inspection of the Work to insure that all the requirements of the Contract have been met and that the Work is complete and is acceptable.

- B. A copy of the report of the inspection shall be furnished to the Contractor as the inspection progresses so that the Contractor may proceed without delay with any part of the Work found to be incomplete or defective.
- C. When the items appearing on the report of inspection have been completed or corrected, the Contractor shall so advise the Owner and the Architect. After receipt of this notification, the Owner or the Architect shall inform the Contractor of the date and time of final inspection.

A copy of the report of the final inspection containing all remaining contract exceptions, omissions and in completions shall be furnished to the Contractor.

- D. After the receipt of notification of completion and all remaining contract exceptions, omissions and in completions from the Contractor, the Owner and the Architect will re-inspect the Work to verify completion of the exception items appearing on the report of final inspection.

Upon completion of re-inspection, the Architect will prepare a certificate of final acceptance or will furnish to the Contractor a copy of the report of the Architect's re-inspection detailing Work that is incomplete or obligations that have not been fulfilled but are required for final acceptance.

END OF SECTION

SECTION 02080

ASBESTOS ABATEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. The Overall Project. The work in this Section specifies the requirements for the abatement of Asbestos Containing Materials (ACM) associated with this contract. The Contractor or its Subcontractor (s) shall perform all work necessary to carry out the proper abatement, collection, handling, storage, transportation and disposal of all asbestos in accordance with Part 56 of Title 12, New York Codes, Rules and Regulations, also known as New York State Department of Labor (NYSDOL) Industrial Code Rule 56 (ICR 56), effective January 11, 2006; in accordance with all applicable Federal, State and Local laws, codes, rules and regulations; and in accordance with the requirements of this Section.
1. Intent. The intent of this Section is to specify the proper removal and disposal of asbestos-containing materials associated with the Work.
 2. Additionally Discovered Asbestos. Contractor shall notify the Owner's Representative of any unknown or suspect asbestos material discovered that was not originally investigated or was presumed to be present. Upon notification and approval from the Owner's Representative, such material shall be abated and properly disposed of in accordance with all applicable Federal, State and Local laws, codes, rules and regulations and the requirements of these Specifications.
 3. Field Verification. The Contractor shall field verify all quantities and locations of asbestos-containing materials which are specified for abatement.
- B. Asbestos Survey Information. For a complete listing of all analytical findings for asbestos, refer to the asbestos survey reports which will be made available on site.
- C. Drawings. 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. Prior to bidding, Contractor is responsible for the confirmation of the actual total quantities of the Work to be performed in connection with submission of the bid.

SUMMARY OF INSPECTION RESULTS FOR ASBESTOS IN WESTCHESTER COUNTY LOW RISE BUILDING 110 MARTIN LUTHER KING JR. BOULEVARD, WHITE PLAINS, NY 10601			
FLOOR	ACM MATERIAL	APPROX. QUANTITY	ABATEMENT METHOD
FIRST FLOOR – DRAWING AA-002			
01	MASTIC UNDER FLOOR TILE	600 SF	NYSDOL ICR-56-11.7 NON-FRIABLE FLOORING & MASTIC REMOVAL PROCEDURES
	VINYL FLOOR TILE AND MASTIC	930 SF	
	VINYL COVE BASE MASTIC	200 SF	
	PIPE AND PIPE FITTING INSULATION – (PACM)	80 LF	NYSDOL ICR-56-7.11(f)(1) NEGATIVE PRESSURE TENT ENCLOSURE
SECOND FLOOR – DRAWING AA-003			
02	VINYL FLOOR TILE AND ASSOCIATED MASTIC	3,000 SF	NYSDOL ICR-56-11.7 NON-FRIABLE FLOORING & MASTIC REMOVAL PROCEDURES
	VINYL COVE BASE MASTIC	365 SF	
	PIPE AND PIPE FITTING INSULATION – (PACM)	80 LF	NYSDOL ICR-56-7.11(f)(1) NEGATIVE PRESSURE TENT ENCLOSURE

D. Asbestos Removal.

1. Procedures. The work of this Section shall be performed as stated herein. It should be noted that this Section may contain requirements that are in addition to the requirements of NYSDOL ICR 56, and that all requirements stated herein shall be performed as stated.
 - a. Use of Full Containment Procedures. These procedures are required for removal of OSHA Class I materials and where the designer determines that these procedures are warranted due to the needs or conditions of the project.

- b. Use of Tent Procedures. These procedures may be utilized for removal of any quantity interior and exterior non-friable asbestos, glove-bag abatement of any quantity friable TSI, or gross abatement of Minor and Small quantities of friable asbestos, and where the designer determines that these procedures are warranted due to the needs or conditions of the project.
 - c. Use of Non-friable Flooring / Mastic Removal Procedures. These procedures are for removal of flooring systems only. For multiple sequential removals involving flooring within the same regulated abatement work area, work area preparation shall follow sequential removal procedures (either full containment or tent). These procedures are not for use when utilizing bead blasting or similar abrasive abatement equipment. See full containment procedures for use of this equipment.
 - d. Use of Applicable Variance AV-A-2. These procedures are for use when standard HEPA exhaust length maximum requirements are exceeded.
 - e. Encapsulation & Encasement/Enclosure of Asbestos In-Place. Encapsulation & Encasement/Enclosure of asbestos materials must utilize non-asbestos repair materials after any loose asbestos material has been removed by conventional removal methods.
2. Regulation / Conflicts. The Contractor shall comply with NYSDOL ICR 56, and all applicable Federal, State and Local laws, codes, rules and regulations. Where codes, rules, and/or regulations conflict, the most stringent shall apply. When an interpretation of codes, rules, regulations, and/or procedures conflict, Owner or Owner's Representative makes the final determination as to what shall apply.
3. Variances.
 - a. No variances may be obtained or used other than those reviewed by Owner's Representative. All variances must be approved by Owner's Representative before submitting to NYSDOL.
 - b. The work of this Section may utilize Applicable Variance AV-A-2. Notifications to the NYSDOL, if so required, must indicate the use of this Applicable Variance. The Contractor must comply with all procedures of this variance.
 - c. Contractor may utilize a Site Specific Variance to conduct the work described herein only after review and written approval from Owner's Representative. Upon stamped approval by the NYSDOL, notifications to the NYSDOL (if so required) must indicate the use of this Site Specific Variance. The Contractor must comply with all provisions of this variance including any conditions imposed by the NYSDOL.
4. Scheduling / Coordination. The Contractor shall coordinate the abatement schedule with Owner's Representative. The needs of facility operations dictate the overall phasing and scheduling. The Contractor must receive approval from Owner's Representative prior to scheduling any shifts.

5. Waste Disposal. Dispose of all asbestos waste generated to an approved asbestos landfill. All applicable laws, codes, rules and regulations including but not limited to New York City Department of Sanitation regulations in relation to transport, storage and disposal of asbestos waste, 6NYCRR Part 364 Waste Transporter Permit, 40 CFR 61 Subpart M Federal Emissions Standards, and 40 CFR 61.25 Waste Disposal sites shall be conformed with. A completed waste manifest/waste shipment record shall be provided to Owner's Representative within 30 days from the time the waste is hauled from the work site.

- E. Contractor Health & Safety Plan. The Contractor shall employ for the work of this Section, a Certified Industrial Hygienist (CIH) to prepare the Health and Safety (H & S) Plan and to develop and implement a personal air monitoring program (Respiratory Protection Program) in accordance with OSHA 29 CFR 1926.1101, good industrial hygiene practices, and the requirements stated herein for asbestos removal.

- F. Contractors Use of Sub-Contractors. If the Contractor uses Subcontractor(s) to perform any of the asbestos abatement work under this Section, including Laboratory work, these Specifications shall apply to the Subcontractor(s) as if specifically referred to herein.
 1. The Subcontractor (s) performing asbestos abatement work shall be considered Asbestos Abatement Subcontractor(s) for the purpose of complying with bidder information and insurance requirements.
 2. Prior to any Subcontractor performing any of the asbestos abatement work under this Section, the Subcontractor must submit a Qualification Package to Owner's Representative for review and written approval.
 3. The Contractor's use of Asbestos Abatement Subcontractor(s) shall not relieve the Contractor of full responsibility for the work to be performed. Nothing provided herein shall create any relationship in contract or otherwise between the Contractor's Subcontractor(s) and Owner's Representative. Further, nothing herein shall create any rights to any third party or obligation on the part of Owner's Representative to any third party.

- G. Contractor Utilities.
 1. The Owner may provide the Contractor with water and power sources where they are available. However, if not available, the Contractor shall supply his own water and power as needed.
 2. The Owner may permit the Contractor to utilize available sanitary facilities where they are available; however the Owner is not obliged to do so. Where the Contractor can utilize on-site sanitary facilities, the Contractor shall clean such facilities at the end of each shift and/or on daily basis. Where the Contractor cannot utilize on-site sanitary facilities, the Contractor shall provide for temporary sanitary facilities sufficient for all workers.

1.2 PERMITS AND NOTIFICATIONS

- A. Notifications. Notify the following agencies of the asbestos abatement activities in accordance with all applicable laws, codes, rules, and regulations:
 1. The New York State Department of Labor shall be notified for all Large Scale Asbestos Removal Projects per location (Building Address or physical space), and also where required by Site Specific Variance conditions. Notifications shall be made to:

New York State DOL, Division of Safety and Health
Asbestos Control Bureau
State Office Campus
Building 12 - Room 454
Albany, New York 12240

2. The United States Environmental Protection Agency shall be notified for all Large Scale Friable Asbestos Removal Projects per location (Building Address or physical space), and also where required by Site Specific Variance conditions. Notifications shall be made to:

USEPA, Region II
Air and Hazardous Material Division
26 Federal Plaza
New York, New York 10278

3. Secure all necessary permits, licenses and/or certifications in conjunction with asbestos handling, removal, hauling and disposal and timely notification of such actions, as may be required by Federal, State, Regional and Local Authorities. Provide Owner's Representative with copies of all required permits and notifications before the start of abatement work.
 4. Notify the New York State Department of Labor, ten (10) days in advance of the commencement of abatement at the Work Site. Notify all the agencies having reporting requirements within the time required by the rules of those agencies or applicable law. Make payment for any filing or other fees associated with such notification
- B. Insurance. Obtain from the insurance carrier for the Contractor and /or the Asbestos Abatement Subcontractor, as applicable, the approval of all asbestos abatement work of this Contract as "Scheduled Project(s) " and provide Owner's Representative with written documentation thereof.
- C. Notice to Proceed. Upon receipt of all applicable permits, approvals and notifications hereunder, the Owner shall issue a permit to the Contractor authorizing him to proceed with the abatement work.
- D. Building Occupant Notification. Notification of nearby persons and/or building occupants shall be posted by the Contractor ten (10) calendar days prior to abatement activity.

1.3 TERMINOLOGY

- A. Abatement: Procedures to control or decrease fiber release from asbestos containing building materials or insulation material containing asbestos. Includes removal, enclosure, encapsulation, repair and handling.
- B. Accepted Methods/Methodologies: Procedures, regulations, or standards, which are published by recognized standards organizations (e.g. NIOSH, ASTM, ANSI), or are included within federal, state or local government regulations (e.g. OSHA, USEPA).
- C. Active Project: A project becomes active when construction of the personal decontamination unit is required to be commenced, or when ACM, PACM or asbestos material is disturbed, whichever comes first, and is considered active until completion of Phase IID, unless in response to a written request, permission is granted by the Department of Labor Construction Managing Services Unit to suspend the work on the project for a specified time period.

- D. Adequately Wet. Sufficiently mix or penetrate a material with amended water to prevent the release of visible emissions. If visible emissions are observed coming from asbestos-containing material, then the material has not been adequately wetted.
- E. Aggressive Sampling: Air monitoring samples collected while a leaf blower, fans, or other such devices are used to generate air turbulence within the Work Area.
- F. Air Filtration Device (AFD): Also referred to as a Negative Air Unit (NAU). A portable local exhaust system equipped with HEPA filtration, capable of maintaining a constant low velocity air flow into contaminated areas from adjacent, uncontaminated areas and capable of maintaining a negative air pressure with respect to the adjacent, uncontaminated areas.
- G. Air Lock: A system for permitting ingress or egress to the Work Area while permitting minimal air movement between a contaminated area and an uncontaminated area, typically consisting of two curtained doorways placed a minimum of three feet apart, minimum three feet wide and a minimum six feet high. If used with a remote decontamination the air lock must have a lockable doorway.
- H. Air Sampling / Air Monitoring: The process of measuring the fiber content of a specific volume of air in a stated period of time using accepted methodologies. Personal air sampling results shall be calculated to reflect the employee's eight-hour time weighted average (TWA) exposure. Area sampling results are reported directly, without calculating the TWA.
- I. Air Sampling Log (See ICR 56-4.5, a): A compilation of information, collected by the Air Monitoring firm, that is maintained and available at the project site when an air monitoring technician is present at site, or can be made available at site by the air monitoring firm within 24 hours of it being requested when no air monitoring is being performed. It contains the following items:
 - 1. Name of the firm and a listing of the certified air sample technicians performing the air sampling, arranged per work shift or day, for all air samples collected;
 - 2. Dates of air sample collection, per work shift or day, of area air samples, with appropriate reference to the regulated abatement work area to which the air samples apply;
 - 3. Sample location sketch, identifying all project air sample locations, per work shift or day, of area air samples. If sample locations are repeated, one common sample location sketch may be utilized for all common air samples;
 - 4. The identifying information for each area air sample collected;
 - 5. Sampling time (24 hour clock), sampling duration, calibration device number and date of last calibration, pre- and -post flow rates for each air sample collected;
 - 6. Chain of Custody with results for each work shift or day of area air samples.
- J. Ambient Air Monitoring. A method of sampling by which an air sample is collected outside the regulated abatement work area, and is collected without the use of aggressive air sampling techniques.
- K. Amended Water: Water to which a surfactant has been added.

- L. Asbestos Abatement Contractor Daily Project Log. As per ICR 56-7 a bound daily narrative journal maintained by the asbestos abatement contractor's supervisor, maintained on-site which contains a synopsis of all pertinent events that occur throughout Phase II of the asbestos project. It shall include the follow at a minimum.
1. Work stoppage due to high results (time, result of barrier & negative air inspection, summary of necessary repairs and required cleanings);
 2. Manometer readings if manometers are utilized (twice per work shift);
 3. Daily negative air system inspections – results - repairs required (even on days with no work shifts);
 4. HVAC System Positive Pressurization inspections – results - repairs required (even on days with no work shifts);
 5. Barrier Inspections – results - repairs required (even on days with no work shifts), twice on days with work shifts;
 6. Daily Testing of Barriers and Enclosures – results – repairs required;
 7. Daily Cleaning of Enclosures;
 8. Time & Results of all Intermediate Completions;
 9. Time of Visual Inspections by Project Monitor & Supervisor for Clearance Air Sampling and Area Exempt from Clearance Air Sampling; and
 10. Final Inspection Documentation.
- M. Asbestos-Containing Material (ACM): Any material or product, which contains greater than 1 percent (1%) asbestos by weight, also known as asbestos material.
- N. Asbestos Project: Work that involves the removal, encapsulation, enclosure, repair or disturbance of friable or non-friable asbestos, or the handling of asbestos material that may result in the release of asbestos fibers. For additional information see ICR 56-2.1 (w).
- O. Asbestos Project Air Sampling Technician. An individual or entity that is authorized to perform the project air sample collection for the work described herein under the direction of THE OWNER; also known as the Air Monitoring Sub-Consultant.
- P. Asbestos Project Monitor. An individual or entity that is authorized to conduct industrial hygiene inspection and third-party air monitoring for the work described herein under the direction of THE OWNER; also known as the Asbestos Consultant, or Environmental Consultant.
- Q. Authorized Visitor: Any party on an asbestos project, who has to enter the asbestos project restricted area or regulated abatement work area for emergency purposes or regulatory compliance inspections. Examples include the building/structure owner, his or her agent or representative, utility company representatives, the Commissioner or his or her agents, and personnel of any regulatory agency having jurisdiction over the project. Visitor shall comply with all applicable requirements of OSHA 29 CFR 1926.

- R. **Background Air Sampling.** A method used to determine airborne fiber concentrations in the area where abatement work is to be conducted, prior to starting of Phase IIA of the asbestos project.
- S. **Barriers.** Critical Barriers and Isolation Barriers.
- T. **Building/Structure.** A structure wholly or partially enclosed within exterior walls and a roof, intended to afford shelter to persons, animals or property; or a structure used as a conveyance for utilities, vehicular traffic or pedestrians (e.g. bridge, tunnel, manhole, subsurface conduits).
- U. **Bulk Sampling.** Accepted methods for collecting samples of suspect materials for appropriate analyses by NYS Environmental Laboratory Approval Program (ELAP) approved laboratories, to determine asbestos content.
- V. **Certified Industrial Hygienist (CIH):** One certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.
- W. **Class I Asbestos Work:** OSHA term meaning activities involving the abatement of Thermal System Insulations (TSI), and surfacing ACM and PACM.
- X. **Class II Asbestos Work:** OSHA term meaning activities involving the abatement of ACM which is not TSI or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic.
- Y. **Class III Asbestos Work:** OSHA term meaning Repair and Maintenance operations, where no more than a minor quantity of ACM, including TSI and surfacing ACM and PACM, is likely to be disturbed.
- Z. **Class IV Asbestos Work:** OSHA term meaning Maintenance and Custodial Activities during which employees contact but do not disturb ACM or PACM and activities to clean-up non-ACM dust, waste and debris resulting from Class I, II and III activities.
- AA. **Clearance Air Sampling.** An accepted method of air sampling used upon completion of final cleaning, during Phase IIC of the asbestos project. This method consists of using aggressive air sampling techniques to dislodge and stir up remaining asbestos fibers, and then air samples are collected for appropriate analysis to determine representative airborne fiber concentrations.
- BB. **Competent Person:** A person who is capable of identifying existing or predictable hazards in the workplace or its surrounding area, including asbestos hazards, and who is authorized and trained under applicable local, state and federal regulations, rules and guidelines to take prompt corrective measures to eliminate such hazards by selecting the appropriate control strategies. See 29 CFR 1926 and ICR 56.
- CC. **Containment.** The negative-pressurized enclosure within the restricted area, which establishes the regulated abatement work area and surrounds the location where the asbestos abatement is actually taking place.
- DD. **Critical Barrier.** Barriers that seal off all openings to or within the defined regulated abatement work area, including but not limited to operable windows and skylights, doorways, ducts, grills, diffusers and any other penetrations to surfaces adjacent to or within the regulated abatement work area.

- EE. Curtained Doorway: An assembly which consists of at least three (3) overlapping sheets of 6-mil fire retardant plastic over an existing or temporarily framed doorway, used to separate the chambers within the decontamination system enclosures and to inhibit airflow if the negative air ventilation system shuts down.
- FF. Decontamination Enclosure System: A series of connected rooms for the decontamination of workers (a Personnel Decontamination Enclosure System) or of materials and equipment (Equipment Decontamination Enclosure System). The specific arrangement is outlined by ICR 56-7.5 and is regulated work area dependant (depends upon size).
- GG. Emergency. An unexpected, unanticipated or unforeseen occurrence, including but not limited to, a steam, chemical, gas or water line rupture, a boiler failure, a building/structure collapse, or act of nature which may pose: (1) an imminent danger to the health and safety of the public; or (2) an asbestos-related risk to the health and safety of the public from release of asbestos fibers.
- HH. Emergency Asbestos Project. An asbestos project which is necessary to respond to an emergency.
- II. Encapsulant (Sealant): A liquid material which can be applied to ACM and which 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).
- JJ. Encapsulation: Application of an encapsulant to asbestos containing materials to control the possible release of asbestos fibers into the ambient air.
- KK. Enclosure: DOL approved procedures necessary to completely enclose ACM behind airtight, impermeable, permanent barriers.
- LL. Equipment Decontamination Enclosure System: A decontamination system for waste materials and equipment, typically consisting of a designated area of the Work Area, a washroom, and a holding area, with an Air Lock between any two adjacent rooms and a curtained doorway between the holding area and the non-work area. Not to be used for personnel entry/exit.
- MM. Excursion Limit (EL): The EL is an airborne concentration of asbestos to which no employee shall be exposed when not using respiratory protection. The EL is 1.0 f/cc as averaged over a 30-minute period.
- NN. Fixed Object: A unit of equipment or furniture in the Work Area, which cannot be removed from the Work Area.
- OO. Friable: Any material which, when dry, may be crumbled, pulverized, or reduced to powder by hand pressure.
- PP. Full Face Piece High Efficiency Respirator (FFHER): A respirator which covers the wearer's entire face from the hairline to below the chin and which is equipped with a HEPA filter.
- QQ. Glovebag Technique. A method for removing asbestos material from heating, ventilating, and air conditioning (HVAC) ducts, piping runs, valves, joints and elbows, and other non-planar surfaces, by use of a glovebag.
- RR. Half Mask High Efficiency Respirator (HMHER): A respirator that covers one-half of the wearer's face, from the bridge of the nose to below the chin, and is equipped with HEPA filters.

- SS. HEPA Filter: A high efficiency particulate air (HEPA) filter capable of trapping and retaining 99.97 percent of the fibers of 0.3 micrometer or larger in diameter.
- TT. HEPA Vacuum Equipment: High efficiency particulate air (HEPA) filtered vacuuming equipment having a UL 586 filter system capable of collecting and retaining asbestos fibers.
- UU. Holding Area. A chamber in the waste decontamination enclosure utilized for temporary storage of containerized ACM waste, prior to transfer to waste transport vehicle.
- VV. Incidental Disturbance Asbestos Project. The cleanup, repair or encapsulation of less than 10 square feet or less than 25 linear feet of incidentally and unintentionally disturbed ACM, PACM or asbestos material.
- WW. Intact. Asbestos material that has not been crumbled, been pulverized, or otherwise been damaged or disturbed and the material's matrix has not noticeably deteriorated.
- XX. Isolation Barriers. Installed temporary hardwall barriers that complete the containment enclosure and establish the regulated abatement work area.
- YY. Large Asbestos Project / Large Scale Asbestos Project: An asbestos project involving the removal, disturbance, enclosure, encapsulation, repair or handling of 160 square feet or more of ACM, PACM or asbestos material or 260 linear feet or more of ACM, PACM or asbestos material.
- ZZ. Lockdown Encapsulant: Procedure of applying an encapsulant as a protective coating or sealant to a surface from which ACM has been removed in order to control and minimize airborne asbestos fiber generation that might result from residual asbestos-containing debris.
- AAA. "THE OWNER" shall mean Westchester County.
- BBB. Minor Asbestos Project / Minor Scale Asbestos Project: An asbestos project involving the removal, disturbance, enclosure, encapsulation, repair or handling of 10 square feet or less of ACM, PACM or asbestos material or 25 linear feet or less of ACM, PACM or asbestos material.
- CCC. Movable Object: Equipment, furniture or other item that is not attached, in whole or in part, to a floor, ceiling, wall or other building structure or system or to a fixed object.
- DDD. Multiple Abatements. The abatement of more than one type of ACM within the same containment.
- EEE. Non-Asbestos Material. Any material documented to contain one percent (1%) or less of asbestos.
- FFF. Non-Friable ACM. Materials that contain more than one percent (1%) asbestos that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure. NESHAPS further classifies Non-friable ACM by type of material: Category I - Packings, gaskets, resilient floor covering and asphalt roofing products; Category II – all materials that are not Category I.
- GGG. Non-Friable Organically Bound (NOB) Asbestos Material. Non-friable asbestos materials embedded in flexible-to-rigid asphalt or vinyl matrices, including but not limited to flooring materials, adhesives, mastics, asphalt shingles, roofing materials and caulks.

- HHH. **Owner's Representative:** Any individual or entity acting on behalf of THE OWNER in managing the project such as a Project Construction Manager, Environmental Consultant, Facility Construction Manager, Project Manager or Architect of Record.
- III. **Personal Decontamination System Enclosure:** An area designated for controlled passage of all persons to and from the regulated abatement work area.
- JJJ. **Personal Protective Equipment (PPE).** Disposable work suits or coveralls, head covering, eye protection, footwear, gloves and appropriate NIOSH-approved respirators with appropriate NIOSH-approved filters.
- KKK. **Permissible Exposure Limit (PEL):** The PEL is an airborne concentration of ACM to which no employee shall be exposed when not using respiratory protection. The OSHA PEL is 0.1 f/cc expressed on an 8-hour time weighted average (TWA).
- LLL. **Plasticize:** To cover floors, walls and ceilings or other surfaces with 6-mil fire-retardant plastic sheeting.
- MMM. **Powered Air Purifying Respirator (PAPR):** Either a full facepiece, helmet, or hooded respirator that passes breathing air to the wearer after the air has been purified through a HEPA filter.
- NNN. **Pre-Cleaning:** The phase of Work Area preparation involving cleaning surfaces in and around the Work Area (including those areas that may be in contact with the asbestos) utilizing HEPA-filtered vacuum equipment and/or wet cleaning. Methods that raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, are prohibited. Asbestos materials which are the subject of removal shall not be disturbed during pre-cleaning.
- OOO. **Presumed Asbestos Containing Material (PACM).** All Thermal System Insulation and Surfacing Materials found in buildings constructed no later than 1980. PACM is considered to be ACM unless proven otherwise by appropriate bulk sampling and laboratory analysis.
- PPP. **Project Monitor.** See Asbestos Project Monitor.
- QQQ. **Public.** Any natural person except: (1) A person engaged in an asbestos project; (2) An authorized visitor; (3) Police, fire, or other public safety personnel.
- RRR. **Regulated Abatement Work Area:** The portion of the restricted area where abatement work actually occurs (i.e. – interior limits of tents, interior limits of containments, interior limits of the restricted area on exterior non-friable removals).
- SSS. **Removal:** Abatement, consisting of operations where ACM, PACM or asbestos material is removed or stripped from structures or substrates. This includes demolition operation.
- TTT. **Restricted Area.** A restricted area established and marked for the abatement portion of an asbestos project. This area shall include, but not limited to asbestos project regulated abatement work areas and any contiguous decontamination facilities, adjoining staging areas where work materials, debris or waste from such work may accumulate, remote decontamination areas, and waste storage areas (dumpsters, trailers, etc.).
- UUU. **Sequential Abatement.** The abatement of different types of asbestos containing material within a common regulated abatement work area in a priority order (See ICR 56-8.6).

- VVV. Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.
- WWW. Tent Procedure: Procedures which shall be accomplished in constructed tents, plasticizing and sealing all surfaces not being abated within the tent periphery forming an enclosure. The tent construction depends upon the amount and friability of the asbestos to be removed from within. Tents that are greater than 20 square feet of floor space, or tents scheduled for gross removal of friable ACM / PACM, shall be required to be constructed of two layers of 6 mil minimum fire retardant plastic sheeting. Tents less than 20 square feet of floor space and not scheduled for gross removal of friable ACM / PACM, may be constructed of a single layer of at least 6 mil fire retardant plastic sheeting. Both tents require seams heat-sealed or double folded, mechanically fastened and duct taped airtight and then duct taped flush with the adjacent tent wall. An airlock shall be contiguous to the entrance/exit of the tent. This is a single use barrier that shall not be used once dismantled or collapsed. The tent shall be attached to the surface to provide an airtight seal except for the attached airlock. Negative air pressure shall be used to continuously exhaust the enclosed area and negative air pressure shall be demonstrated by smoke testing. If negative pressure is achieved by use of a HEPA filtered vacuum (minor project removals), the hose shall be attached securely and airtight through the tent wall at the most remote location possible from the ACM to be disturbed. For all tents a minimum of four volume changes per hour is required.
- XXX. Thermal System Insulation. Insulation material applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat gain or loss.
- YYY. Time Weighted Average (TWA): The TWA is an 8-hour, weighted average of airborne asbestos as measured in fibers per cubic meter.
- ZZZ. Type C Respirator: A respirator which supplies at a minimum Grade "D" air to the wearer from a source outside the Work Area by means of a compressor.
- AAAA. Variance (Site Specific). Relief in accordance with Section 30 of the Labor Law from specific sections of Industrial Code Rule 56 for a specific project.
- BBBB. Variance (Applicable) (AV). Blanket relief in accordance with Section 30 of the Labor Law from specific sections of Industrial Code Rule 56 for a particular type of project.
- CCCC. Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with amended water and by afterwards disposing of these cleaning tools as asbestos-contaminated waste.
- DDDD. Work Site: Building, structure, parcel of land or premises where an asbestos project takes place.

1.4 REFERENCES: LAWS, CODES, RULES, AND REGULATIONS

- A. Versions. Comply with all applicable laws, codes, rules and regulations including, but not limited to, the requirements stated herein. References to laws, codes, rules, regulations, standards, or other Federal, State and local requirements shall be deemed to mean the latest version or revision thereof, or successor thereto, notwithstanding any change in numbering or designation to titles.
- B. Applicable Local Regulations. City of New York Laws and Regulations, including but not limited to:

1. New York City Local Law 70, 1985, Chapter 31, Title A New York City Administrative Code as amended by Local Laws 21 and 80, 1987; approved November 25, 1985; currently in effect.
 2. New York City Department of Sanitation Regulations in Relation to Transport, Storage and Disposal of Asbestos Waste, promulgated November 26, 1986; effective December 30, 1986.
- C. Applicable Federal Regulations. Occupational Safety and Health Administration (OSHA) Regulations, including, but not limited to:
1. United States Department of Labor, Occupational Safety and Health Act Standards, 29 CFR Part 1910.20, 1910.134, 1910.145, 1910.1001, 1910.1200, and 1926 Subpart C, 1926.1101.
 2. Title 40 CFR, Subchapter 1, Solid Wastes (Parts 260 through 268).
 3. United States Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants (NESHAPS) 40 CFR 61.
 4. Title 49, CFR (Code of Federal Regulations) Part 171, Hazardous Substances; Part 172, Hazardous Materials Tables and Hazardous Materials Communications Regulations, Subpart B and C; Part 173, Shippers - General Requirements for Shipments and Packaging.
- D. Other Applicable Federal Regulations.
1. United States Department of Transportation (USDOT) Standards.
 2. United States Environmental Protection Agency (USEPA) Standards, including, but not limited to:
 - a. EPA 560 OPTS86-0011, September 1986, A Guide to Respiratory Protection for the Asbestos Abatement Industry.
- E. Applicable State Regulations. State of New York:
1. State of New York Article 30-Labor Law, Asbestos or Products Containing Asbestos Licensing 12 NYCRR-Part 56 Asbestos Regulations.
 2. Title 10, Part 73, New York State Code of Rules and Regulations, Asbestos Safety Program Requirements, promulgated August 13, 1987, effective September 3, 1988.
 3. Title 12, Part 56, Rules and Regulations of the State of New York, effective January 11, 2006.
 4. Environmental Conservation Law Article 27, enacted 1972; most recently amended December 1, 1987.
 5. Other:
 - a. 6NYCRR Part 360, Solid Waste Management Facilities and Associated Buildings, as amended, effective April 1, 1987.

- b. Part 364, New York State Code of Rules and Regulations, Waste Transporter Rules, effective January 10, 1985; revised December 30, 1985.

1.5 REFERENCES: ORGANIZATION STANDARDS

A. Organization Standards: The following Organization Standards shall apply, as referenced:

1. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) PUBLICATIONS:

Z9.2-79 Fundamentals Governing the Design and Operation of Local Exhaust Systems

Z8.2-80 Practice for Respiratory Protection

Z86.1-1973 Commodity Specification for Air

2. UNDERWRITERS LABORATORIES INC. (UL) PUBLICATIONS.

586-77 Test Performance of High Efficiency Particulate Air Filter Units

586-85 Standard for High-Efficiency Particulate Air Filter Units

250 Grounding and Bonding Equipment

3. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) PUBLICATION:

D1331-56 Surface and Interfacial Tension of Solutions of Surface-Active Agents

4. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) PUBLICATION:

70-1993 National Electrical Code (NEC)

1.6 SUBMITTALS

Abatement submittals refer to all of the project documentation generated on the asbestos removal project.

The Abatement Contractor is required to submit documentation prior to mobilization to the project site (Pre-Construction Submittals), during on-going removal activities (During-Abatement Documentation) and at the conclusion of all site activities (Post Construction Submittal).

The Project Air Monitoring consultant is similarly required to submit During Abatement Documentation and a Post Construction Compilation of Documents.

The Project Monitoring consultant is only required to submit a Post Construction Compilation of their, Air Monitor's and Abatement Contractor's Construction Documentation.

A. Abatement Contractor Pre-Construction Submittals Content. Submit these documents as directed by Owner's Representative.

1. General. All Pre-Construction Submittal documents listed per this section are generally required prior to the mobilization for the project.
2. Timing. Submit to Owner or Owner's Representative two weeks in advance of start of abatement work for review and approval (except as noted).

3. Health and Safety Plan. A Health and Safety Plan shall be submitted for review. Approval from THE OWNER or Owner's Representative is required prior to Contractor's mobilization.
4. Proof of a respiratory protection program. Submit a separate Respiratory Protection Program prepared by a Certified Industrial Hygienist if respiratory protection plan is not already included as a part of the Health & Safety Plan.
5. Notifications. Proof of written notifications required by Paragraph 1.02, "Permits and Notifications" of this Section. Proof that all required permits have been obtained.
6. Minimum Qualifications Required. Documentation of compliance with:
 - a. Proof of work experience and successful completion of required EPA-certified AHERA training courses for the job supervisors, foremen, and workers.
 - b. Proof that the job supervisors, foremen, and asbestos abatement workers meet State certification and license requirements.
 - c. Provide the name of the designated job supervisor(s) and foremen.
 - d. Proof of a current medical surveillance program for all subcontractor personnel to work on this abatement.
7. Proof of historic airborne fiber data (Exposure Assessment). Submit level of respiratory protection intended for each procedure required by the work. Submit airborne asbestos fiber monitoring data from an independent air-monitoring firm to substantiate selection of respiratory protection proposed (exposure assessment).

Lack of historic airborne fiber data requires the Contractor to perform an exposure assessment to determine the proper respiratory protection required, during which time the maximum protection that can reasonable be expected for the type of removal work must be implemented (see Respiratory Protection Program, section 1.06 C 4. above).

Historic airborne fiber data shall include the following for each procedure required by the work:

 - a. Date of measurement.
 - b. Type of work task monitored.
 - c. Methods used for sample collection and analyses.
 - d. Number, duration and results of samples taken.
8. Landfill Selection. Proof that a landfill site has been located for disposal of asbestos-contaminated or Asbestos-Containing Materials. Provide the name and location of the landfill. Landfill shall be an asbestos-only receptor for all friable or potentially friable asbestos materials removed.

9. Transporter Selection. Proof that a transporter has been located and arrangements for transport of asbestos-contaminated or Asbestos-Containing Materials have been made. Provide the name and transporter permits (NYS Part 364) of the waste transport company.
10. MSDS. Manufacturers' literature on all proposed job related equipment and products to be used on this Project must be submitted to Owner's Representative for Approval before the start of work. Include Safety Data Sheets (SDS) and product labels for encapsulant; fire retardant plastics, surfactant and other chemicals to be used.
11. Work Plan. A detailed Asbestos Removal and Disposal Work Plan that describes all aspects of the abatement work to be performed.

The Plan shall include the following:

- a. A detailed description of the Work Area enclosure. Provide shop drawings (with dimensions and locations) of proposed decontamination facilities and work areas. These drawings shall indicate the following:
 - 1) Areas to be sealed off and Work Area boundaries.
 - 2) Proposed layout and location of the decontamination enclosure systems. Include a detailed description of any modifications or changes to be made to the specified negative pressure Work Area enclosure.
 - b. Specimen of the daily log proposed for use. Minimally, the log should include the date(s) and time(s) when all personnel enter and leave the work area(s).
12. Schedule. Contractor shall use "Primavera" software to prepare the schedules. All schedules shall include projected dates, days and hours for all major phases of removal noting major milestones. All work schedules should be coordinated with THE OWNER or Owner's Representative. Contractor shall submit updated progress schedules along with the progress invoices.
 13. Variance. Prior to the start of work, a copy of the approved variance must be submitted to Owner's Representative by the Contractor.

B. Abatement Contractor During-Abatement Documentation.

1. Schedule of Work Changes: Any changes in the Schedule of Work proposed by the Contractor shall be submitted to Owner's Representative for review and approval no later than seven days prior to the commencement date of the proposed change. A revised schedule indicating actual occurrences shall be submitted at the end of each week when delays occur or proposed milestones are not met.
2. Notarized Payroll. Notarized copy of payroll showing a previous wage rate has been paid shall be submitted to the Owner's Representative. Contractor shall use DOL form for wage payment.
3. Project Monitor Inspection Requests. The Contractor shall request in writing all required inspections and document it in their logbook. The Project Monitor shall co-sign in the contractor's logbook that the inspection was performed and will indicate the outcome of the inspection.
4. OSHA Sampling Results. Results of all air monitoring performed by the Contractor shall be posted within 24 hours after collection for all workers to see.

- C. Air Monitoring Consultant During-Removal Air Sample Log.
 - 1. Air Results: Shall be supplied on site according to the scheduled turnaround times indicated.

- E. Abatement Contractor Post Construction Submittal (Close-out Documents). To be sent to THE OWNER or Owner's Representative for review. It shall include the following:
 - 1. Project Log Book. A copy of the bound log book showing the date(s) and time(s) of entrance to and exit from the Work Area(s) for all persons, inspection requests, and inspection sign-offs.
 - 2. Air Results. Compilation in chronological order of all OSHA air monitoring records pertaining to this Project.
 - 3. Waste Manifests. Compilation of all completed and signed Waste Shipment Record forms, bills of lading, or disposal receipts pertaining to this project.
 - 4. Notifications. Copies of notifications to applicable agencies that the asbestos abatement work has been completed.
 - 5. Removal Contractor Qualifications. Removal Contractor firm's NYSDOL License, Individual worker NYSDOL License (s), medical clearances, and fit tests.

- F. Air Monitoring Consultant Close-out Documents. To be sent to Owner. It shall include the following.
 - 1. Air Sampling Log
 - 2. Certifications. Copies of NYSDOL licenses for all air sample technicians and the firm.
 - 3. Lab Certifications. Copies of NYSDOH ELAP certifications for all laboratories utilized.

- G. Project Monitoring Consultant Post Abatement Documents (Closure Report). To be sent to THE OWNER or Owner's Representative. It shall include the following.
 - 1. Project Monitoring Inspector Reports. All site log entries, field inspections performed, and memos issued.
 - 2. Project Monitoring Qualifications. Project monitoring firm's NYSDOL License & Individual Project Monitor's NYSDOL License (s).
 - 3. Air Monitoring Consultant Close-out Documents.
 - 4. Removal Contractor Close-out Documents.

1.7 QUALITY ASSURANCE

- A. The Asbestos Abatement Contractor shall have the following minimum qualifications for the performance of the asbestos abatement required by this Contract:
 - 1. The Contractor shall have at least five (5) years applicable experience in the performance of asbestos abatement projects.

2. The Contractor shall be licensed to perform asbestos abatement work by the NYS DOL in accordance with ICR 56.
 3. All Contractor employees involved in asbestos abatement shall be certified in accordance with ICR 56.
 4. The Contractor shall provide at least ten (10) verifiable references that demonstrate the Contractor's ability to adequately provide the required services.
 5. The Contractor shall provide documentation that the minimum insurance criteria have been met.
- B. The Contractor shall provide certification that the Contractor has not been the subject of any legal or administrative action or proceeding brought by the New York State Department of Labor (NYS DOL), the United States Environmental Protection Agency (USEPA), the New York State Department of Environmental Conservation (NYS DEC), the New York City Department of Environmental Protection (NYC DEP), the United States Occupational Safety and Health Administration (OSHA), or any other Federal, State or local agency having safety, health, or environmental responsibilities or function; or
1. If the entity has been the subject of legal proceedings, lawsuits, claims or citations levied by any Federal, State or local governmental agencies for any past or present hazardous material activities, submit a description of same, and describe how the allegations were resolved; and if the entity has been associated with hazardous material projects which have been prematurely terminated, provide a description of such projects including circumstances surrounding termination.
- C. The Contractor shall demonstrate, prior to award, that the Contractor can supply the labor, supervision, materials, equipment, insurances and expertise required to perform the work of this Section.

PART 2- PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials provided under this Section shall be standard products of manufacturers regularly engaged in the production of the materials and shall conform to OSHA Standard 29 CFR 1926.1101; EPA Standard 40 CFR 61, Subpart M; Department of Transportation Standards 49 CFR 171, 172, and 173; applicable Federal, State and Local laws, codes, rules and regulations, as well as, all other requirements specified herein SDS's for all chemicals must be provided to Owner's Representative as required under Pre-Construction submittals.

A. Markings and Labels: Disposal bags and shipping containers shall bear danger labels, transportation packaging labels, and generator identification information. Labels shall be permanently affixed to all bags and shipping containers containing ACM, in accordance with OSHA Standard 29 CFR 1926.1101(k)(2), USDOT Standard 49 CFR Part 171 and 172, and EPA Standard 40 CFR Part 61.150(a)(1)(v).

1. Danger label format and color shall conform to OSHA Standard 29 CFR 1926.200. Danger labels shall display the following legend/information:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG
DISEASE HAZARD

2. USDOT Marking and Labels: Markings and labels shall be permanently affixed to all bags and containers containing ACM, in accordance with USDOT 49 CFR 172.304 and 172.407.

- a. Markings shall display the following text:

RQ, ASBESTOS, NA 2212

- b. Labels shall be diamond shape and shall be located near the Marking text. Labels will consist of a diamond a minimum of 100 millimeters (mm) (4 inches) on each side with each side having a solid line inner boarder 5.0 to 6.3 mm (3/6" to 1/4") from the edge. The label shall be white with seven black vertical stripes on the top half. Black stripes and white spaces shall be equally spaced. The lower half of the label shall be white with the class number "9" underlined and centered at the bottom. Refer to USDOT 40 172.446 for label format.

3. Generator identification information shall be affixed to each USDOT label format and color shall conform to USDOT Standard 49 CFR 172.304. Generator identification information labels shall display the following legend/information:

GENERATOR'S NAME:
GENERATOR'S 24 HOUR PHONE:
GENERATOR'S FACILITY ADDRESS:
DATE OF WASTE GENERATION: xx/xx/20xx

B. Duct Tape: Duct tape shall be capable of sealing joints of adjacent sheets of plastic and of attaching plastic sheeting to finished surfaces without damage to existing finish and shall be capable of adhering under both dry and wet conditions, including use of amended water.

- C. Other Materials: All other materials, such as lumber, tools, scrapers, brushes, cleaning materials, adhesive, nails, hardware, etc., which are required to perform the work described in this Section shall be provided. Materials and equipment shall be new or used, uncontaminated by asbestos, in serviceable condition, and appropriate for the intended purpose.
- D. Plastic: Provide fire retardant plastic of 6-mil thickness in rolls of sizes that will minimize the frequency of joints. Fire retardant plastic sheet shall be used for plasticizing the enclosed Work Area, for preparation of the decontamination enclosure system, and for waste packaging.
- E. Plywood: Plywood used for temporary partitions and decontamination enclosure systems, shall be an exterior grade and a minimum of 3/8-inch thick.
- F. Reinforced Fire Retardant Plastic: Provide reinforced polyethylene sheeting for critical barrier and decontamination enclosure construction. Reinforced polyethylene sheeting provided for this project shall be a 3-ply, high-density flame resistant-reinforced-polyvinyl chloride film. Plastic color shall be opaque.
- G. Reuse of Containers: If impermeable containers used to transport bagged asbestos waste to the landfill are to be reused, the empty containers shall display the following label:

RESIDUE:
LAST CONTAINED ASBESTOS RQ (or "Residual Quantity")

- H. Shipping Containers: Impermeable containers shall be suitable to receive and retain any asbestos-containing or asbestos-contaminated materials until they are disposed of at an approved landfill. The containers shall be labeled in accordance with this Section. Containers shall be both airtight and watertight and conform to USDOT Standard 49 CFR 178.224. Each container shall be constructed of fiber, hard plastic, or metal, with locking, airtight lids.
- I. Warning Signs: Warning Signs shall be posted at the perimeter of the work area prior to abatement operations in accordance with OSHA Standard 29 CFR 1926.1101. Danger sign format and color shall conform to OSHA Standard 29 CFR 1926.200. The signs shall display the legend indicated below:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE
CLOTHING ARE REQUIRED IN THIS AREA

2.2 EQUIPMENT

Equipment provided under this Section shall conform to applicable Federal, and State and local laws, codes, rules, regulations, and the requirements specified herein.

- A. Fall Protection Equipment: Certified and approved equipment to be used by trained personnel when working at a high elevation to protect against falling.

- B. Fire Extinguisher: Type "ABC" dry chemical extinguisher or a combination of several extinguishers of NFPA recommended types for the fire hazard exposures in each extinguisher location shall be provided. Minimum size of extinguisher shall be 4-A, and 40-B: C. Supply a minimum of one extinguisher for every 1,000 square feet of floor area, with a maximum travel distance to an extinguisher of 75-feet. Supply at least one extinguisher in each decontamination enclosure equipment room, and clean room.
- C. Power Tools: Provide power tools necessary to complete the work. Power tools used directly for asbestos removal shall be equipped with a dust collection system. Attach a manufacturer approved or manufacturer provided shroud connected to a HEPA vacuum system for capture of dust.
- D. Smoke Detectors: Smoke detectors of the battery powered ionization type will be required at a rate of one per 5,000 square feet, with a minimum of one smoke detector in the decontamination enclosure clean room, and one in the Work Area.

2.3 WORKER PROTECTIVE CLOTHING AND ASSOCIATED EQUIPMENT

Protective clothing and equipment shall conform to OSHA Standard 29 CFR 1926.1101.

- A. Equipment: Eye protection and hard hats required for job conditions or by applicable safety regulations shall be provided.
- B. 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.
 - 1. Provide authorized visitors, Owner, Owner's Representative and sub-consultants suitable properly fitting protective disposable clothing, headgear, hard hats, eye protection, respiratory protection, and footwear (up to six sets per 8-hour shift) whenever they are required to enter the Work Area.
- C. Respiratory Protection: Provide adequate respiratory protection at all times for all individuals in the Work Area. Types of respirators used shall be approved by NIOSH for asbestos in accordance with OSHA Standard 29 CFR 1926.1101 and 29 CFR 1910.134. Provide a level of respiratory protection, which supplies an airborne fiber level inside the respirator below 0.01 fibers per cubic centimeter (f/cc), as the minimum level of protection allowed. Determine the proper level of protection by dividing the actual airborne fiber count in the Work Area by the "protection factors" given below for each respirator type:

Respirator Type	Protection Factor
Air purifying: Negative-pressure respirator, High efficiency HEPA filter, Half-facepiece	10
Air purifying: Negative-pressure respirator, High efficiency HEPA filter, Full-Face piece	50
Powered air purifying (PAPR): Positive pressure respirator High efficiency HEPA filter, Full-face piece	1000
Type C supplied air:	1000

Positive-pressure respirator,
Pressure-demand,
Full-face piece
HEPA escape

Type C supplied air:
Pressure-demand,
Full-face piece
equipped with an auxiliary SCBA

1000

1. 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 Standard 29 CFR 1926.1101, and as more stringently specified otherwise, herein.
2. During the use of supplied air systems, provide authorized visitors, THE OWNER's Asbestos Sub-consultant and Air Monitoring Sub-consultant with individually issued and marked respiratory equipment (up to six units). Respiratory equipment shall be compatible with the supplied air system in use, and shall be suitable for the asbestos exposure level(s) in the Work Area(s), as specified in OSHA Standard 29 CFR 1926.1101, and as more stringently specified otherwise, herein.
3. Where respirators with disposable filter parts are employed, provide sufficient filter parts for replacements as necessary or as required by applicable regulation.
4. Breathing air supply systems shall conform to the USEPA NIOSH Document EPA-560-OPTS-86-001 (September 1986) entitled "A Guide to Respiratory Protection for the Asbestos Abatement Industry."
5. Have a minimum of two spare air hoses with connectors to permit THE OWNER's Asbestos Sub-consultant and Air Monitoring Sub-consultant to connect assigned Type C Respirator to the air system at any time without having to wait for personnel to exit the Work Area in order to obtain a spare hose.

PART 3 - EXECUTION

3.1 GENERAL: REMOVAL AND DISPOSAL OF ASBESTOS

- A. The Contractor shall remove and dispose of all asbestos-containing waste materials generated in the Work Area and enumerated in this Specification.
- B. The Contractor shall protect against asbestos contamination.
- C. The Contractor shall supply and install temporary light and power in the Work Area in accordance with all electrical codes as well as compliance with the requirements of ICR 56-7.7.
- D. The Contractor shall provide a hot water heater of sufficient size to permit workers to take hot showers. Water temperature shall be adjustable from within the shower chamber.
- E. Asbestos related work shall in no way allow or create conditions which may result in the movement of air which has potential for containing asbestos fibers from any part of the Work Site.
- F. The Contractor shall load all contaminated waste in asbestos waste bags/containers, which are pierce resistant.
- G. All waste haulers shall be fully permitted for transporting asbestos waste. The Project Monitor shall verify that the haulers adhere to all applicable laws, codes, rules and regulations in relation to Transport, Storage and Disposal of asbestos waste.
- H. In areas where stored materials are in contact with asbestos materials or are contaminated with asbestos debris the Contractor shall properly decontaminate those materials whether they are to remain in the asbestos removal area or are to be removed and stored in another area.
- I. The Contractor shall safely access all areas requiring abatement.
- J. The Air Monitoring firm shall perform all required tests and submit results as required for acceptance. Quality Control and testing criteria shall be performed in accordance with all applicable laws, codes, rules and regulations.
- K. The Contractor shall provide and pay for the OSHA Compliance Air Sample Results.
- L. The Project Monitor shall monitor the Asbestos Abatement Contractor's compliance with all applicable laws, codes, rules and regulations, variances to these rules, and these Specifications.
- M. The Contractor shall provide a Site Supervisor during the asbestos abatement project. The Site Supervisor shall meet all supervision, training and manpower requirements as defined in the Specifications and all applicable laws, codes, rules and regulations.
- N. The Contractor shall provide a three ring binder containing copies of the certificates, notifications, permits, written respirator program, respirator fit test records, training records and all medical examination records for the entity and all personnel assigned to the abatement work. It shall be on Site and reviewed and approved by THE OWNER or Owner's Representative prior to the commencement of any asbestos related work.

- O. Any damages to THE OWNER's facilities shall be repaired to the satisfaction of THE OWNER or Owner's Representative at no additional cost to THE OWNER, in accordance with the Contract Terms and Conditions.
- P. All materials shall be lowered from any elevation and no materials are to be dropped from any height. All scaffolding shall meet OSHA requirements, have kick plates, and shall comply with the requirements of New York State Labor Laws.
- Q. The Contractor shall provide 24 hours notice and receive approval from THE OWNER or Owner's Representative, should the work schedule change for any reason.
- R. At minimum, a licensed electrician utilized by the Contractor within the asbestos work area, must possess a Restricted Asbestos Handler license.
- S. The Contractor shall follow the following sequence of abatement activities inside **full containment abatement** work areas:
 - 1. Finalize the pre-abatement submittals, notifications and work schedule.
 - 2. Systems shall be shut down as needed, and Project site meeting ("opening") shall be held.
 - 3. The work area shall be vacated of non-certified personnel and cordoned off using barrier tape.
 - 4. Post signs and Copies of Notifications according to NYSDOL ICR 56 and as specified elsewhere in this Work Plan.
 - 5. A personal decontamination enclosure system that complies with ICR 56-7.5 (a-d) and a waste decontamination enclosure system that fully complies with ICR 56-7.5 (e-f) shall be utilized.
 - 6. Ensure that the Environmental Consultant has performed area monitoring and established a background count prior to the preparatory operations for each removal area, as applicable.
 - 7. 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-contaminated waste.
 - 8. 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.
 - 9. 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 OWNER.
 - 10. Pre-clean all fixed objects to remain within the Work Area using HEPA-vacuum and wet-cleaning techniques.
 - 11. Seal fixed objects with a minimum of two, individual layers of 6-mil, fire retardant polyethylene sheeting.

12. Pre-clean entire Work Area utilizing using HEPA-vacuum(s) and wet-cleaning techniques with water amended with a surfactant. Methods of cleaning that raise dust, such as dry sweeping or use of vacuum equipment not equipped with HEPA-filters is prohibited.
13. 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 polyethylene sheeting and duct-tape.
14. Construct rigid framework to support Work Area barriers.
 - a. Framework shall be constructed using 2-inch by 4-inch wooden 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.
 - b. 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 polyethylene sheeting may be substituted for the rigid construction material.
 - c. Caulk all wall, floor, ceiling, and fixture joints to form a leaktight seal.
15. Seal floor drains, sumps, shower tubs, and other collection devices with two layers of 6-mil plastic and plywood, as necessary, and provide a system to collect all water used by the Contractor. Collected water shall be passed through a water filtration system prior to being discharged into the sanitary sewer.
16. 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.
17. Fiberglass pipe insulation and fiberglass duct insulation located within the work area boundaries shall be removed and disposed as asbestos waste. Non-ACM plaster duct insulation shall be protected in place during abatement activities. These materials shall be protected with two layers of 6-mil polyethylene sheeting as isolation barriers and two additional layers of 6-mil polyethylene sheeting serving as primary and secondary surface barriers.
18. Install and initiate operation of AFDs to provide a negative pressure and a minimum of four (4) 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 OWNER following final clearance procedures. The use of HEPA-filtered vacuum to produce a negative air pressure inside the enclosure is prohibited.

19. 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.
20. Temporary lighting within the Work Area and decontamination system shall be provided as required to achieve appropriate illumination levels.
21. Hand power tools used to drill, cut into, or otherwise disturb ACM shall be equipped with HEPA filtered local exhaust ventilation.
22. 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. Plasticize the area after pre-cleaning, using the following procedures:
 - a. Cover floors with one layer of 6-mil polyethylene sheeting, turning layer a minimum of 6 inches up wall, and seal layer to wall.
 - b. Cover walls with one layer of 6-mil polyethylene sheeting, overlapping wall layer a minimum of 6 inches, and seal layer to floor layer.
 - c. Cover floors with a second layer of 6-mil polyethylene sheeting, turning layer a minimum of 12 inches up wall, and seal layer to wall.
 - d. Cover walls with a second layer of 6-mil polyethylene sheeting, overlapping wall layer a minimum of 12 inches, and seal layer to floor layer.
 - e. In areas where demolition is required to access ACM, a layer of 6-mil reinforced polyethylene sheeting shall be placed on the floor of the enclosure.
 - f. Perform demolition required to access ACM. Debris resulting from demolition activities shall be disposed of as ACM as described in this Specification.
 - g. Repeat preparation of areas accessed by demolition activities as described above.
23. Scaffolds shall be provided for workers engaged in work that cannot safely be performed from the ground or other solid Work Area surface.
24. Pre-Removal Inspections
 - a. Prior to removal of any ACM, the Contractor shall notify the Environmental Consultant 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 Environmental Consultant.
 - b. Contractor shall correct any deficiencies observed by Environmental Consultant at no additional cost to THE OWNER.
 - c. Following the Environmental Consultant's approval of the Work Area preparations, removal of ACM may commence.
25. Removal of ACM Within Full Containment

- a. Mist the ACM with amended water. Allow sufficient time for the amended water to penetrate the material to be removed.
- b. Contractor shall correct any deficiencies observed by Environmental Consultant at no additional cost to Owner.
- c. Remove the ACM and immediately containerize the ACM and thoroughly clean the components of the substrate. Clean any remaining asbestos containing debris and utilize wet cleaning methods to thoroughly clean the substrate and the interior of the work area enclosure until no visible debris/residue, pools of liquid, or condensation remain.
- d. Remove any residual material from the substrate using wet cleaning methods and nylon-bristled hand brushes.
- e. Place the removal material immediately into a properly labeled 6-mil polyethylene bag. All material shall be properly containerized and decontaminated prior to removal from the Work Area.
- f. Following the completion of removal of ACM, all visible residue shall be removed from the substrate.
- g. Sequential removal shall allow for only one type of removal of ACM at a time in a sequential order within the work area until that type of material is completely removed. First, all ceiling plaster or similar ceiling OSHA Class I friable material shall be completely abated. Then the friable mechanical/tank insulation, vibration cloths and thermal pipe and pipe fitting insulation, duct insulation or similar OSHA Class I or Class II friable material shall be completely abated. Second, OSHA Class II non-friable materials shall be abated. Lastly, OSHA Class II non-friable flooring and mastic shall be abated.
- h. When any abated material leaves an exposed asbestos containing material end exposed, the exposed end shall be sealed with a non-asbestos wettable cloth. Seal pipe and duct ends where additional ACM extends beyond the work area boundaries with lag canvas (re-wettable canvas (lag canvas)). The lag canvas shall cover and conceal remaining asbestos material and create an airtight seal.

26. First Cleaning:

- a. Remove any visible accumulation of asbestos material and debris. HEPA-vacuumping and wet cleaning shall be performed on all surfaces inside the Work Area, including the substrate. All sealed drums, plastic bags, and equipment used in the Work Area shall be removed from the Work Area.
- b. Upon request of the Contractor, the Environmental Consultant will perform a visual inspection. Evidence of asbestos contamination identified during the inspection will necessitate further cleaning as heretofore specified.
- c. Remove first layer of plastic sheathing inside the Work Area. The isolation barriers and decontamination facility shall remain in place and be utilized.

27. Second Cleaning:

- a. After the first cleaning, the Work Area shall be vacated for twelve hours to allow fibers to settle.
- b. All objects and surfaces in the Work Area shall be HEPA - vacuumed and wet cleaned for a second cleaning.

- c. A thin coat of lockdown encapsulant shall be applied to all plastic covered surfaces in the Work Area.
 - d. 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.
28. Third Cleaning:
- a. A minimum of four hours after the second cleanup, all the surfaces in the Work Area shall be HEPA-vacuumed and wet cleaned for a third cleaning.
 - b. Upon the request of the Contractor, the Environmental Consultant for observing whether cleaned areas are free of dust, dirt, and debris will do final visual inspection for re-occupancy. Evidence of asbestos contamination identified during the inspection will necessitate further cleaning as heretofore specified.
 - c. When the Work Area passes the Environmental Consultant's visual re-occupancy inspection, air sampling shall not begin until at least one hour after the completion of the third cleanup. The Environmental Consultant shall perform air monitoring using aggressive testing techniques. The Environmental Consultant will approve Re-occupancy if the specified fiber count in the Work Area is achieved.
 - d. When the Work Area passes the re-occupancy test, all controls established should be removed.
29. Final Barrier Removal:
- a. Upon receipt of acceptable clearance testing results, polyethylene sheeting and Isolation Barriers shall be removed and disposed accordingly as asbestos-containing material.
 - b. The area surrounding the abatement work place shall be cleaned of any visible debris utilizing HEPA vacuum and wet methods.
30. The Environmental Consultant will conduct a final visual observation. Approval must be granted prior to break down of decontamination facility and contractor demobilization.
31. Removal of asbestos-containing floor tiles, cove base & mastic:
- a. Refer to the architectural drawings for the phasing of the work. These drawings are diagrammatic for the sole purpose of indicating ACM to be removed. Coordinate with THE OWNER the location of emergency exits, negative air exhaust and waste routes. Contractor shall perform all work in accordance with NYSDOL industrial code rule 56 part 12 section 56-11.7.
 - b. Install a worker and waste decontamination facility (DECON), which must be attached to the work area and maintain as per NYSDOL industrial code rule 56. The DECON shall be utilized as the entrance and exit for each work area. Coordinate the location of each decontamination unit with THE OWNER prior to installation

- c. NYSDOL certified asbestos handlers and supervisors wearing dual HEPA cartridge negative pressure respirators and two (2) full body TYVEK coveralls will perform all work procedures as described herein. The respirator shall meet all OSHA, NIOSH, and MSHA standards for asbestos dust. All personnel entering the work area shall wear respiratory protection. All abatement work shall be conducted under the direct supervision of a NYSDOL certified asbestos supervisor, who shall be present on-site during all work procedures.
- d. Post approved asbestos warning signs (bilingual) and demarcate the area to prevent entry by unauthorized personnel.
- e. Establish and maintain a "notification board" posting (in plain view on the exterior of the DECON the required certifications, placard, licenses, and documentation in accordance with applicable regulations.
- f. Asbestos containing materials to be removed shall not be disturbed until all engineering controls are established.
- g. Restrict access to the work site using warning tape and critical barrier to designate the work area as off limits to unauthorized personnel.
- h. Shut down and lockout electrical and HVAC service in the work area.
- i. Provide temporary lighting and power to the work area in accordance with OSHA requirements for work area safety. All electric work shall be performed in accordance with applicable codes.
- j. HEPA vacuum and wet clean all surfaces within the work area.
- k. Install negative air machines (MICROTRAPS) to establish a negative pressure in the work area equal to 0.02 inches of water column or greater. Exhaust all work area air outdoors.
- l. Secure with duct tape and spray adhesive two separate layers of six mil poly on all openings (i.e. windows, doors, vents) as critical barriers.
- m. Secure with duct tape and spray adhesive two separate layers of six mil poly on all light fixtures, non-movable objects, etc. Being careful not to cover the floor.
- n. Notify ATC to inspect the work area for compliance with all applicable regulations prior to the start of ACM removal. Upon approval by ATC, Contractor shall begin removal procedures.
- o. All asbestos containing materials to be removed are to be kept wet by constantly misting with amended water. Once the asbestos containing material is removed, it must be immediately placed directly into 6-mil polyethylene disposal bags. Do not allow loose material or visible debris to remain on the floor.

- p. Bags containing asbestos waste shall be misted with amended water, twist shut in a goose neck fashion, and seal with duct tape. Place disposal bags into a second 6-mil polyethylene disposal bag, twist shut in a goose neck fashion, and seal with duct tape. The second disposal bag shall be properly marked with OSHA, USEPA, USDOT and NESHAP labels.
- q. Bagged and labeled waste shall be transported in covered carts from the work area to an enclosed and lockable waste container located in the building driveway on Martine Avenue for subsequent transport by a licensed asbestos waste hauler and disposal at a certified asbestos waste landfill. No asbestos waste shall be transported from the facility without prior approval by ATC and the completion of all waste manifest forms.
- r. Once removal is complete, fine clean the work area with HEPA vacuums and wet wiping techniques. After the work area is allowed to dry completely, it will be inspected by ATC. Upon approval, ATC shall perform clearance air monitoring in accordance with NYSDOL ICR 56 and EPA AHERA regulations.
- s. Re-clean all surfaces in the work area if the inspection or the clearance air tests fail.
- t. Following receipt of acceptable air clearance results and approval by ATC, Contractor shall remove isolation barriers and work area components and demobilize from the site. All polyethylene sheeting, duct tape, suits, etc. shall be disposed of as asbestos containing waste.
- u. Upon completion of the final breakdown procedures, Contractor shall request a final visual inspection from ATC. Upon approval by ATC, the asbestos abatement work area shall be authorized for re-occupancy.

3.2 GENERAL: AIR MONITORING

Air monitoring is delineated into two types: i) Environmental air monitoring (or "Area air monitoring") that is required pursuant to ICR 56 and these specifications for Phase IB through Phase IIC and performed to ensure that the containment practices are functional and to verify that completed regulated abatement work areas are at least as clean as prior to initiation of abatement activities; and ii) Personal air monitoring (or "OSHA personal monitoring") as required by OSHA regulations to establish and ensure proper respiratory protection levels for workers and to ensure adequate Construction Managing practices within the regulated abatement work areas.

A. Environmental / Area Air Monitoring.

1. Responsibility: Environmental / Area air monitoring shall be performed as a part of this Contract by an air monitoring firm prior to abatement and daily during removal and cleaning. The firm performing this air monitoring must be completely independent of all asbestos abatement contractors involved in this project. The individual performing air monitoring shall be a currently licensed NYSDOL Air Sampling Technician and have in his/her possession their license during all phases of air sampling.

2. Posting. Environmental / Area air monitoring firm shall post at the project site their NYSDOL license during all phases of air monitoring.
3. Documentation. A project air sample log shall be created by the firm performing air monitoring. The Environmental Air Monitoring firm shall submit Post Construction documentation as required.
4. Turnaround Time. For Phase IB samples and Phase IIA & IIB samples where the next workshift is greater than 48 hours later, the period of time permitted between completion of air sample collection and receipt of results on the job site shall be equal to or less than 48 hours.

For Phase IIA & IIB samples where the next workshift is less than 48 hours later, the period of time permitted between completion of air sample collection and receipt of results on the job site shall be equal to or less than 24 hours.

For Phase IIA & IIB samples where the site work is already completed, and all Phase IIC samples, the period of time permitted between completion of air sample collection and receipt of results on the job site shall be as soon as feasible possible (immediate).

5. General Requirements. (See ICR 56-4).
 - a. Number of Air Samples. The air sampling schedule shall be in accordance with Industrial Code Rule 56-4 – Table 2 for all abatements with the exception of Exterior Non-friable and Minor Scale Removals where “during abatement samples” shall be collected as Quality Assurance/ Quality Control (QA/QC). These “during samples” must be less than 0.01 fibers per cubic centimeter of air to declare these work areas completed. Failure of these “during samples” shall require re-sampling.
 - b. Placement.
 - 1) The monitoring shall be performed both inside and outside the work area, as to accurately assess the airborne levels of asbestos fibers.
 - 2) The sampling zone for indoor air sampling shall be representative of the occupant’s breathing zone.
 - 3) Air sampling equipment shall not be placed in corners of rooms or near obstructions such as furniture.
 - 4) Air sampling within the work area shall be randomly dispersed throughout the work area and not concentrated within any one portion.
 - 5) Air sampling outdoors shall be at least ten (10) feet away from obstructions that may influence wind patterns.
 - 6) Air sampling within the building but outside of the work area shall be within ten (10) feet of the critical barriers, decontamination enclosure entrances/exits and negative air ducts and exhausts, as applicable.
 - c. On-Site. The air monitor shall be on-site to observe and maintain air sampling equipment for the duration of air sample collection.

- d. Cooperation. The Contractor shall provide full cooperation and support to the Environmental Air Monitor throughout the abatement process.
- e. Collection Rate. Phase IB (Background), Phase IIA (Work Area Preparation), Phase II B (Asbestos Handling) and Phase IIC (Final Cleaning & Clearance) air samples shall be collected at a minimum flow rate of 2 liters per minute (ICR 56-4), the maximum is dependant upon the method of analysis (16 liters per minute for NIOSH 7400 PCM, 10 liters per minute for TEM AHERA).
- f. Method.
 - 1) PCM analysis shall be according to NIOSH Analytical Method 7400 (A counting rules) at a minimum and by a laboratory that is approved by the New York State Department of Health Environmental Laboratory Approval Program (NYSDOH ELAP) for the chosen analysis method and a successful participant in the NIOSH Proficiency Analytical Testing Program (PAT).
 - 2) If Transmission Electron Microscopy (TEM) is the selected method of analysis, the clearance criteria and sampling protocols of Asbestos Hazard Emergency Response Act (AHERA) shall be used.
 - 3) If PCM air sample analysis results exceed the satisfactory clearance criteria, then TEM analysis of the entire set of clearance air samples may be used under the direction of THE OWNER's Representative provided that each sample is reported as fibers per cubic centimeter and all results (PCM & TEM) are submitted to the Commissioner.
- g. Methodology Reference. Environmental / Area air sampling shall be conducted as specified in the following documents except as restricted or modified herein.
 - 1) Measuring Airborne Asbestos following an Abatement Action; United States Environmental Protection Agency Document 600/4-85-49 (Nov. 1985);
 - 2) Guidance for Controlling Asbestos - Containing Materials in Building; United States Environmental Protection Agency Publication 560/5-85-025 (June 1984);
 - 3) Methodology for Measurement of Airborne Asbestos by Electron Microscopy; United States Environmental Protection Agency Contract No. 68-02-3266;
 - 4) NIOSH 7400 Method, Revised.
- 6. Elevated Fiber Counts / PCM Phase IIA through IIC Fine Cleaning. The handling of elevated fiber counts at or above 0.01 fibers per cubic centimeter or above the established background level shall be as follows.
 - a. Work shall immediately stop for inspection and repairs of barriers and negative air ventilation systems (as necessary).
 - b. Clean-up of the surfaces outside of the regulated abatement work area using HEPA-vacuums and wet cleaning methods shall be performed prior to resumption of work.

- c. These activities, inspections, results of inspections shall be documented in the Supervisor's daily project log.
- d. Work methods shall be altered accordingly to reduce fiber concentrations to acceptable levels.
- e. Upon receipt of the elevated fiber results the Project Monitor is required to notify the Contractor, and then submit the elevated fiber results along with background results within the same business day to the Commissioner of the NYSDOL.

Notification to the Bureau may be by mail or fax:

Asbestos Control Bureau – New York City District

345 Hudson Street, Room 7023

New York, New York 10014

Fax: 212-352-6902, Telephone: 212-352-6084 (6109)

7. Phase IIC Clearance.

- a. Aggressive Sampling Techniques.
 - 1) Pre-Sampling Agitation. Before starting clearance air sampling, the exhaust of forced air equipment shall be directed against all surfaces in the Regulated Abatement Work Area at a rate of five (5) minutes per 1,000 square feet of floor area.
 - 2) Ongoing Agitation. At least a 20-inch fan shall be placed in the center of each room with one (1) fan per 10,000 cubic feet of room space used. The fan shall be operated on low and pointed toward the ceiling.
- b. Acceptable Results.
 - 1) PCM. The PCM Clearance air sample results shall be considered satisfactory when every clearance air sample demonstrates an airborne concentration of fibers of less than 0.01 fibers per cubic centimeter, or established background level, whichever is greater. If PCM Clearance air sampling analysis results exceed the satisfactory clearance criteria, then TEM analysis of the entire set of clearance air samples may be used with the direction of THE OWNER's Representative.
- c. Unacceptable Results.
 - 1) If Clearance air sampling analysis results on the inside work area group of air samples are unsatisfactory, the Project Monitor shall notify and direct the Contractor to clean-up the regulated abatement work area using HEPA-vacuums and wet cleaning methods, followed by another drying time period and then collection of an additional full set (insides and outside) of air samples. This shall be repeated until satisfactory results are obtained.

- 2) If only the Clearance air sampling analysis results of the outside work area group of air samples is unsatisfactory, upon notification sequence outlined in # 1 above, clean-up of surfaces outside of the regulated abatement work area using HEPA-vacuums and wet cleaning methods shall be performed prior to collection of an additional group of outside air samples. This shall be repeated until satisfactory results are obtained.
- 3) Within two (2) business days of attaining satisfactory Phase IIC Clearance air sample results where there were previously unsatisfactory Phase IIC Clearance air sample results (either PCM or TEM), the air sampling technician is required to submit background results, all previously unsatisfactory Phase IIC Clearance air sample results (PCM & TEM) along with satisfactory Phase IIC Clearance air sample results (PCM or TEM) to the Commissioner in care of the New York City District of the Asbestos Control Bureau. Notification to the Bureau may be by mail or fax:

Asbestos Control Bureau – New York City District

345 Hudson Street, Room 7023

New York, New York 10014

Fax: 212-352-6902, Telephone: 212-352-6084 (6109)

B. Personal Air Monitoring.

1. **Contractors' Air Monitoring Requirements.** The Contractor's air monitor shall be responsible for development and implementation of a personnel air monitoring program in accordance with OSHA 29 CFR 1926.1101 and good industrial hygiene practices. Air monitoring shall be performed by an Industrial Hygiene (IH) monitor supervised by the Contractor's Certified Industrial Hygienist (CIH). Documentation of air sampling shall include as a minimum, calculations of limits; sampling time; sampling location (or subject); evidence of periodic inspection of sampling equipment; documentation of daily pre-and post-calibration of sampling equipment; detailed description of worker protective equipment; description of any atypical environmental conditions; and a description of work practices/procedures/controls in operation during the sampling period. Documentation of sample analysis shall include, as a minimum, sample identification; total sample duration, sample flow rate; the "Limit of Reliable Quantification"; total air volume; total fibers counted (with work sheets); total fields counted; blank filter analysis; and reticule field area. Airborne fiber concentrations in fibers per cubic centimeter (f/cc) shall be calculated and reported at the 95 percent confidence level.

2. **Collection Requirement.** Full shift personal exposure air sampling of workers shall be performed to establish the eight-hour Permissible Exposure Limit-Time Weighted Average (PEL-TWA) exposure. Such sampling shall be conducted for each employee (or representative group of employees) expected to evidence the highest exposure in each Work Area for each type of activity on the first shift that site preparation, removal, or cleanup activities anticipated to produce the highest airborne concentrations to determine the Excursion Limit. The Excursion Limit is defined as a 15 minute TWA exposure which should not be exceeded at any time during the workday even if the 8-hour TWA is within the PEL-TWA. Personal exposure sampling shall be repeated at least every third day for areas where removal and cleanup operations are conducted for more than one week, or at any time that conditions indicate to the Contractor or the Contractor's CIH that the most recent personal sampling results are no longer indicative of employee exposure. Phase Contrast Microscopy (PCM) personal samples shall be collected and analyzed according to the OSHA Reference Method in OSHA 29 CFR 1926.1101. The Contractor shall post all personal exposure air sampling results at the project site.
3. **Rate.** The minimum percentage of workers to be sampled shall be 20 percent as recommended.

3.3 DECONTAMINATION ENCLOSURE SYSTEM

A. General.

1. Provide a personnel decontamination enclosure system and an equipment decontamination system in accordance with OSHA 29 CFR 1926.1101, and New York State ICR 56-7.5, and as specified herein. The dimensions and configuration of the decontamination enclosure systems is dependant on the crew size.
2. The size of the personal and waste decontamination enclosure systems for this project depend upon the scale of the regulated abatement work area (s) that shall utilize them; see 'Impacted Quantities Table' Section 1.01 C.1. for this (these) work area (s). Note: More than one enclosure system may be required, and where multiple enclosure systems are required, the systems may or may not be of the same size.
3. The decontamination enclosure systems shall be provided outside the regulated abatement work area and attached to all locations where personnel and/or waste shall enter or exit the regulated abatement work area.
4. One personal & waste decontamination enclosure system for each regulated abatement work area shall be required unless a remote personal decontamination enclosure is permitted.
5. The decontamination enclosure systems shall utilize adequate lighting and shall be supplied with a GFCI protected temporary lighting system.
6. Decontamination enclosure systems may consist of existing attached rooms outside the regulated abatement work area, if the layout is appropriate, that can be plasticized and are accessible from the regulated abatement work area. When this situation does not exist, personal decontamination enclosure systems may be constructed of metal, wood or plastic supports covered with fire-retardant plastic sheeting.
7. These decontamination enclosure systems must be kept clean, sanitary and temperature controlled against freezing at all times in conformance with all federal, state and local government requirements.

8. These decontamination enclosure systems shall remain on-site, operational and be used until completion of Phase IIC of the asbestos project.
9. The decontamination enclosure systems shall be located in an area that is pre-approved by THE OWNER, Owner's Representative.
10. Comply with local building codes and all applicable laws, codes, rules and regulations governing temporary structures.
11. Where the enclosure system is constructed at an exterior area the enclosure system must be capable of withstanding, at a minimum, 60 mile an hour winds.

B. Personal Decontamination Enclosure System.

1. Large Project.

- a. **Rooms and Configuration.** The personal decontamination system enclosure shall consist of a clean room, a shower room and an equipment room connected in series but separated from each other by airlocks. There shall be a curtained doorway separation between the equipment room and the regulated abatement work area, and there shall be a lockable door to the outside. Minimum dimensions for each airlock, shower room and equipment room shall be three (3) feet wide by six (6) feet in height, to allow for adequate access to and from the regulated abatement work area.
- b. **Curtained Doorway.** An assembly which consists of at least three (3) overlapping sheets of six (6) mil fire-retardant plastic over an existing or temporary framed doorway. One (1) 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 insure that the sheets hang straight and maintain a seal over the doorway when not in use.
- c. **Framing.** Enclosure systems accessible to the public shall be fully framed; hard-wall sheathed and utilize a lockable door for safety and security.
- d. **Sheathing.** A plywood or oriented strand board (OSB) sheathing material of at least 3/8-inch thickness.
- e. **Prefabricated or Trailer Units.** A completely watertight fiberglass or marine painted pre-fabricated unit does not require plasticizing. The arrangement and use is the same as for site constructed units. Upon receiving satisfactory clearance air results, the prefabricated units shall be sealed then separated from the regulated abatement work area and removed from site.
- f. **Clean Room.** The clean room shall be sized to adequately accommodate a full work shift of asbestos abatement contractor personnel, as well as the air sampling technician and the project monitor. The clean room shall be a minimum of six (6) feet in height. A minimum of thirty-two (32) square feet of floor space shall be provided for every six (6) full shift abatement workers, calculated on the basis of the largest work shift. Additional workers above six (6) shall require the clean room to be enlarged by a multiple of thirty-two (32) square feet of floor space (i.e. – seven (7) workers require a clean room of sixty-four (64) square feet, thirteen workers require a clean room of ninety-six (96) square feet, etc.). If the largest work shift consists of three (3) or less full shift abatement workers, the minimum clean room size requirement is

reduced to twenty-four (24) square feet of floor space. Benches for seating, lockable lockers and coat hooks for storage of worker's street clothing, shelves for storing respirators, and a location for postings shall be provided in this area. Clean disposable clothing, replacement filters for respirators, clean dry disposable towels, and other necessary items shall also be provided in the clean room. The clean room shall not be used for storage of tools, equipment, materials, or office space. A lockable door shall be provided to permit access to the clean room from outside the regulated abatement work area and decontamination enclosure during non-work hours.

- g. Shower Room. The shower room shall contain at least one (1) shower with hot and cold water, adjustable at the tap, for every six (6) workers. Multiple showers shall be simultaneously accessible (installed in parallel) to certified personnel. Careful attention shall be given to the shower to ensure against leaking of any kind. Supply shampoo and soap in the shower room at all times. Provide a system to collect all water used. The collected shower water shall be passed through a 5µm-water filtration system, containerized and transported off Site for disposal.
- h. Equipment Room. The equipment room shall be used for the storage of decontaminated equipment, tools; and up to a one (1) day supply of replacement filters for HEPA-vacuums and negative pressure ventilation equipment in sealed containers; surfactant etc. may also be stored here. Contaminated footwear and work clothes shall be stored in this area. The equipment room shall be of sufficient size to accommodate at least one worker, allowing him to remove protective clothing and footwear, a six mil Disposal Bag in an impermeable container, and any other equipment which the Contractor requires to store when not in use.

2. Small Project.

- a. Rooms and Configuration. A personal decontamination system enclosure for a Small asbestos project shall consist of, at a minimum, an equipment room, a shower room and a clean room separated from each other and the regulated abatement work area and other areas by curtained doorways. All other provisions for personal decontamination system for a large asbestos project shall apply. Equipment storage, personal gross decontamination and removal of clothing shall occur in the equipment room just prior to entering the shower.

3. Minor Project.

- a. Rooms and Configuration. An area adjacent to the regulated abatement work area shall be utilized for decontamination of personnel and equipment. The area shall be lined on the floor with at least a one (1) layer of six (6) mil plastic sheeting, contain at least one (1) HEPA vacuum for cleaning / decontaminating, and be separated from the regulated abatement work area and other areas by curtained doorways. All personnel must enter and exit the regulated abatement work area through this decontamination area. The use of a disposable air lock utilizing PVC supports ('Pop-up air lock') is recommended.

4. Remote Personal Decontamination System Enclosure.

- a. Use. If a personal decontamination system cannot be attached to the regulated abatement work area due to building, fire code or available space

restrictions and is permitted (Exterior Non-friable Removals, negative pressure tent enclosure with glovebag only abatement, or non-friable ACM is being removed in a manner which will not render the ACM friable), a Remote Personal Decontamination System Enclosure may be utilized. Note that limited tearing or breaking of a non-friable ACM does not necessarily make a material friable, however any grinding, abrading or pulverizing of ACM shall be considered as ACM rendered friable.

- b. Configuration. A remote personal decontamination system enclosure shall be configured just as an attached personal decontamination system enclosure, according to the size of the regulated abatement work area, material to be removed and size of crew.
- c. Additional Airlocks. At a minimum, two (2) extra airlocks shall be constructed, one at the entrance to the equipment room or equipment/washroom; the other shall be constructed at the entrance to the containment or regulated abatement work area. These airlocks shall have lockable doorways at the entrance to the airlock. These airlocks shall be cordoned off at a distance of twenty-five (25) feet and posted with the appropriate OSHA signs.
- d. Location. The remote personal decontamination system shall be constructed as close to the regulated abatement work area as physically possible. If the remote personal decontamination system must be located at the exterior of the building/structure, it shall be constructed within fifty (50) feet of the building or structure exit used for access by the asbestos abatement contractor personnel. The decontamination unit shall be cordoned off at a distance of twenty-five (25) feet to separate it from public areas.
- e. Protective Clothing. Workers shall don two (2) sets of disposable protective clothing and a supply of protective clothing shall be kept in the airlocks attached to the regulated abatement work area.
- f. Designated Pathway. The walkway from the regulated abatement work area to the remote personal decontamination system or the next regulated abatement work area shall be cordoned off and posted with the appropriate OSHA signs and signage in accordance with ICR 56-7.4(c) while in use during Phases IIA through IID.
- g. Remote Personal Decontamination Use. The worker shall HEPA-vacuum and/or wet wipe his/her outer protective clothing while in the regulated abatement work area, then proceed into the airlock, which serves as a changing area, where he/she shall remove the outer clothing and don a clean set of protective clothing. The worker may then proceed to the personal decontamination system enclosure or another work area. Travel to any other area is not permitted.
- h. Remote Personal Decontamination Removal. The remote personal decontamination unit shall be removed only after satisfactory clearance air sampling results have been achieved.

C. Waste Decontamination System Enclosure System.

- 1. Large & Small Asbestos Projects.

- a. **Rooms and Configuration.** A waste decontamination system enclosure shall consist of a washroom and a holding area connected in series but separated from each other by an airlock. There shall be a curtained doorway separation between the washroom and the regulated abatement work area, and there shall be a lockable door to the outside.
 - b. **Curtained Doorway.** An assembly which consists of at least three (3) overlapping sheets of six (6) mil fire-retardant plastic over an existing or temporary framed doorway. One (1) 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 insure that the sheets hang straight and maintain a seal over the doorway when not in use.
 - c. **Washroom.** The washroom is a room/chamber between the regulated abatement work area and the holding area where equipment and waste containers are wet cleaned or HEPA-vacuumed. The washroom shall be equipped with a wash bin of sufficient size to perform waste container washing operations and shall have a submersible pump installed to collect waste water and deliver it to the shower waste water filtration system where it shall be filtered. Careful attention shall be given to ensure against leaking of any kind.
 - d. **Equipment Washroom Alternative.** Where there is only one (1) exit from the regulated abatement work area (large or small asbestos project), the washroom for waste decontamination may be common with the equipment room of the personal decontamination system enclosure. The holding area of the waste decontamination enclosure shall then branch off from this common equipment and washroom combination.
2. **Small Asbestos Projects - Shower/Washroom Alternative.**
- a. **Limited Access to Regulated Abatement Work Area.** Where there is only one (1) exit from the regulated abatement work area, the shower room may be used as a waste washroom. The clean room shall not be used for waste storage, but shall be used for waste transfer to carts, which shall be immediately removed from the enclosure. Waste shall be transferred only during times when the showers are not in use.
3. **When a Remote Personal Decontamination Enclosure is Allowed.**
- a. **Minor Size Regulated Abatement Work Area.** No separate waste decontamination area is required – waste generated shall be immediately bagged/containerized within the regulated abatement work area.
 - b. **Small & Large Size Regulated Abatement Work Area.** An additional chamber shall be constructed attached to the existing airlock used to access the work area (this existing airlock is required on all regulated abatement work areas except for Special Project Removals – Roofs, where workers do not have to enter an enclosed publicly occupied space). The washroom/airlock combination shall be utilized as the contiguous waste decontamination 'washroom' enclosure for waste bagging/containerization and waste transfer activities. The washroom shall be constructed and supplied with equipment/materials consistent with waste decontamination system enclosure washroom requirements for contiguous personal and waste decontamination system enclosures.

3.4 GENERAL PERSONNEL PROTECTION AND DECONTAMINATION PROCEDURES

- A. General. The Contractor shall take all safety measures and precautions necessary to protect his employees, site visitors, utilizing the work site in accordance with all applicable laws, codes, rules, and regulations including, but not limited to OSHA 29 CFR 1926.1101, EPA 40 CFR, Part 61, Subpart M; and applicable State laws, codes, rules, and regulations. The Contractor shall be solely responsible for enforcing personnel protection requirements.
1. Workers or authorized visitors shall not eat, smoke, drink, or chew gum or other substances while on the Site, Work Areas or decontamination areas.
 2. Contaminated worker footwear, eye protection, and hard hats shall be removed in the air lock, upon completion of asbestos abatement, disposed of as asbestos contaminated waste, or decontaminated for reuse.
 3. Except for regulatory agency inspectors with jurisdiction, no visitors except those authorized by THE OWNER, Owner's Representative shall be allowed in the Work Areas.
- B. Worker Respiratory Protection. With the approval of the Contractor's CIH, historical airborne fiber level data shall serve as the basis for selection of the level of respiratory protection as outlined in the Contractor's Health & Safety Plan (HASP).
- C. Personnel Entrance and Decontamination Procedures for Asbestos Removal Operations. The entry/exit procedures used for areas prepared as asbestos removal operations: Pursuant to ICR 56-8.3(a) The entry/exit procedures for areas prepared as asbestos removal Work Areas shall be as follows:
1. All workers and authorized visitors shall remove street clothes and change into two protective suits in the decontamination enclosure systems prior to entering the Work Area. Before exiting the Work Area all workers and authorized visitors shall remove their outer protective suits in the air lock and place the suit in a labeled waste Disposal Bag located within the work area. All workers and authorized visitors shall proceed directly to the decontamination enclosure system immediately upon exiting the Work Area.
 2. When employing a remote decontamination unit, Asbestos handlers involved in the Work Area 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 of the Personal Decontamination Enclosure at the Work Site. Workers shall be fully protected with respirators and protective clothing from the time of first disturbance of asbestos containing or asbestos contaminated materials prior to commencing actual asbestos abatement, until final cleanup is completed.
 3. 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, contractor(s), the Project, and each Work Area and worker respiratory protection employed. Maintain all of the logs during the abatement activity.
 4. Establish an access route between each Work Area and the decontamination unit and maintain positive control over, including restricting access to, each of the routes.

3.5 INITIAL NOTIFICATION AND PRE-MOBILIZATION ACTIVITIES

- A. Building Occupant Notifications.

1. Ten 10 Day Notice. As required by ICR 56-3.6, the Contractor shall prepare and post for the building owner ten (10) days prior to commencement of Phase II A work a notice to all persons in the vicinity of the work concerning the pending abatement. Posted notice shall be provided at all direct means of access to the floor. This will remain in place for the duration of the abatement work. Included in this notice are the abatement contractor's name and contact information, Project Monitor / Air Monitor / Laboratory firm names and contact information, estimated start and end dates and the materials / quantities / locations of proposed work.
- B. Regulatory Notifications and Record Keeping. File all necessary regulatory notifications as required, see section 1.02 A.
- C. Pre-Construction Meeting. THE OWNER, Owner's Representative shall stage a Pre-Construction meeting to discuss the scope of work, implementation or the abatement practices, participant's responsibilities and the effect on the operations of the facility. All concerned or affected parties may be invited including but not limited to:
 1. The Abatement Contractor.
 2. The Asbestos Project Monitor
 3. Owner Representatives from the Facility Operations, Maintenance, Management, etc. as needed.
- D. Phase IB Air Sampling. Request that the Air Monitoring consultant perform area air monitoring and establish a background count prior to abatement contractor mobilization and starting of Phase IIA work area preparation for each removal area. Note that the highest sample result per group (either inside or outside) shall establish background levels for that intended regulated abatement work area.
- E. Lock Out Tag Out. Where applicable, the facility or General Contractor shall shut down and lock-out all electrical and mechanical services to the Work Areas.

3.6 WORK AREA PREPARATION

- A. OSHA Sampling. Contractor shall implement personal air sampling program as required.
- B. Phase IIA Air Sampling. Air sampling shall be initiated as required for all work shifts. Air monitoring is not required on days when no Phase II A activities are performed.
- C. Establishing Regulated Abatement Work Areas.
 1. Communications. Ensure that the Contractor's communication equipment is in place, in operating condition, and in operation during work described in this Section.
 2. Vacating Area. The regulated abatement work area shall be vacated by occupants and non-certified personnel prior to work area preparation.

3. **Restricting Entry.** Establish a 10-foot radial exclusion zone from the outermost perimeter of the Work Area (solid and fixed barriers excluded), except for exterior non-friable removals where the exclusion zone shall be twenty-five (25) feet. The exclusion zone will be comprised of barrier tape. The exclusion zone shall be considered part of the Work Area. Only NYSDOL licensed individuals shall be allowed to enter. Public access to this area shall be restricted by use of caution signs meeting the requirements of OSHA 29 CFR 1926.1101 shall be posted at all approaches to locations where airborne concentrations of asbestos may exceed ambient background levels.
4. **Establishing Decontamination Facilities.** Provide / install personal decontamination enclosure systems in accordance with Paragraph 3.01 of this Section and make fully functional prior to commencing the remainder of Phase IIA activities. Once functional: all access to the regulated abatement work area shall be via the installed personal decontamination system enclosure and full PPE shall be worn during preparation activities in compliance with current OSHA regulations in regulated abatement work areas for all friable OSHA Class I or Class II asbestos projects. Waste decontamination system enclosures shall be constructed and functional at the completion of Phase IIA preparation activities.
5. **Isolation of Electric.** Electric Power within the regulated abatement work area shall shut down and lock-out if not already done so. Electric Power Shutdown Exemption, if required, shall be in compliance with ICR 56 Part 7.7 (a).
6. **Heating, Ventilation, and Air Conditioning (HVAC) Systems.** Pursuant to ICR 56-7.9, isolate HVAC systems by shutdown and isolation, local isolation, or positive pressurization. Any potentially contaminated HVAC filters shall be handled and disposed of as asbestos contaminated materials.

3.7 PREPARATION OF REGULATED ABATEMENT WORK AREA

- A. Moveable & Fixed Objects. All moveable and fixed objects within the abatement work area shall be pre-cleaned using HEPA-filtered vacuums and/or wet cleaning methods. All moveable objects shall be removed from the area, fixed objects shall be enclosed with two (2) layers of at least six (6) mil fire retardant plastic sheeting.
- B. General Pre-cleaning. The entire regulated abatement work area is to be pre-cleaned utilizing HEPA-filtered vacuums and/or wet cleaning methods. Pre-cleaning is intended for preparation work, not gross cleaning of visible asbestos that has been disturbed.
- C. Barrier Pre-cleaning. Contractor shall pre-clean at locations of future critical and isolation barriers, and where future tent structures will be affixed to existing structures / walls / floors / ceilings.
- D. Critical Barriers. For containments other than tents, seal off all penetrations with two (2) independent layers of at least six (6) mil fire-retardant plastic sheeting.
 - 1. Tent Decontamination Enclosure Requirements.
 - a. The size of decontamination enclosure is dependant upon the amount of asbestos removed within the tent.
 - b. For gross abatement of friables materials, attached decontamination system enclosures are required.
 - c. Minor size work areas shall have at a minimum decontamination areas set-up and utilized.
 - d. All tents that utilize a remote decontamination facility shall have an airlock attached to the tents entrance.
 - 2. Tent Layers.
 - a. Tents greater than twenty (20) square feet of floor space, and / or gross removal of friable asbestos require the tent to be constructed of two (2) layers of six (6) mil fire-retardant plastic sheeting.
 - b. Tents with twenty (20) square feet of floor space or less, and no gross removal of friable asbestos require the tent to be constructed of one (1) layer of six (6) mil fire-retardant plastic sheeting.
 - 3. Tent Isolation. All tents shall be cordoned off for twenty-five (25) feet, or the interior limits of the room and shall be posted with appropriate OSHA warning signs.
- E. Isolation Barriers. Install temporary hardwall isolation barriers (min 3/8-inch thick) to complete the enclosure and establishing the limits of the regulated abatement work area containments. All opening greater than 32 square feet (except where one dimension is one foot or less) shall require framing. All seams must be appropriately sealed and then treated as a critical barrier (covered with two (2) independent layers of at least six (6) mil fire-retardant plastic sheeting).
- F. Establish Negative Air. Establish negative air as required for the specific attachment procedure.

1. Requirement. Negative air shall be maintained continuously to provide the required air changes in the regulated abatement work area every hour until satisfactory clearance air sampling or the project is completed. Negative air for Minor size tents may be shut-off after collection of clearance air samples and sealing of tent.
 - a. Full Containment Removal – four (4) air changes per hour.
 - b. Tent Removal of Non-friables – four (4) air changes per hour.
 - c. Tented Glovebag Removal of TSI – four (4) air changes per hour.
 - d. Flooring Containment Removal – six (6) air changes per hour.
 - e. Gross Removal of Friables in a Tent – eight (8) air changes per hour.
 2. Manometer. Required on all OSHA Class I ('Friable') Large & Small size regulated abatement work areas.
 3. Exhaust Requirements. Exhaust ducting shall not exceed twenty-five (25) feet in length. If greater lengths are required, provisions of AV-A-2 shall apply (see ATTACHMENT AV-A-2). Exhaust terminations shall be to the exterior of the building or structure and away from public access and to a controlled area. This controlled area shall be comprised of a four (4) foot high construction fence with appropriate OSHA warning signs a minimum of ten (10) feet from this termination point. Furthermore, all receptors within fifteen (15) feet of this termination point shall be plasticized with two (2) layers of at least six (6) mil fire-retardant sheeting.
 4. Exemption from Exhaust Requirements. HEPA-filtered vacuums used to exhaust Minor size tent enclosure regulated abatement work area, do not require exhausting to the exterior of the building/structure.
- G. Work Area Pre-cleaning. The remainder of the containment (non-tent) work areas is now pre-cleaned so that plasticization may occur.
- H. Plasticizing and Sealing. All floor, wall and ceiling surfaces except where abatement is to occur shall be covered with two (2) layers of at least six (6) mil fire-retardant plastic sheeting as per the schedule outlined in ICR 56-7.11 (e) for Full Containment work areas. The ceiling, wall and floor surfaces for Floor Removals need not be plasticized for manual and chemical removals.
- I. Plasticizing and Sealing – Spray Plastic, Full Containment. In lieu of two (2) layers of plastic sheeting on all wall, ceiling and floor surfaces, spray plastic may be utilized as per ICR 56-7.11 (2).
- J. Suspended Ceiling, Full Containment. Non-asbestos suspended ceilings below asbestos shall remain in place until the entire below ceiling work area has been established. Phase IIB may not commence until removal of the suspended ceiling has been completed and all critical and isolation barriers required installed in the opened space has been completed.
- K. Pre-Removal Inspection. Prior to removal of any ACM (initiation of Phase IIB), notify the Project Monitor and request a pre-removal inspection. This inspection will include the verification that warning signs are posted, construction of isolation barriers, plasticizing of Work Areas, building of personnel and equipment decontamination enclosure systems, and all other preparatory steps shall have been completed prior to notification of the Project Monitor. Do not begin asbestos removal until the Project Monitor approves the Work Area preparations.

3.8 WASTE HANDLING

A. Waste Removal from Work Area.

1. External surfaces of the waste container (bag) shall be wet wiped or HEPA vacuumed prior to transfer of container to waste decontamination area, except in Minor size regulated abatement work area where containerization, cleaning, second containerization and cleaning will all be performed within the regulated abatement work area.
2. Waste transferred to the waste decontamination area shall be wet cleaned and containerized again (double bagged in the case of bags).
3. All asbestos waste shall be labeled with the Generator's Label and according to current EPA NESHAPS regulations.
4. An area for temporary storage of asbestos waste containers/dumpster must be pre-approved by THE OWNER or Owner's Representative. Asbestos waste may only be stored in a restricted area or enclosed container which is posted and secured whenever not in use.
5. Asbestos waste may stay no longer than one (1) week in the holding area of the waste decontamination area. The waste shall be dated upon removal from the waste holding area to the container.
6. Carts utilized for transport of waste from the waste decontamination area to the waste trailer or dumpster shall be watertight and have doors or tops that can be closed and secured. The carts shall be HEPA vacuumed and wet cleaned at least once per day.
7. Waste transport trailers and dumpsters shall be hard topped, lockable and lined with two (2) layers of six (6) mil fire-retardant polyethylene.

B. Waste Removal from Work Site. (see ICR 56-10)

1. All bagged asbestos materials must be transported by a permitted waste hauler. Hauler must obtain and provide proof to THE OWNER's Representative or his designated representative of all necessary hauling permits.
2. Ensure that all asbestos waste from the Work Site is stored, transported and disposed of in accordance with all applicable Federal, State and local Laws, codes, rules and regulations.
3. Asbestos waste may stay in a lockable trailer or lockable hard top dumpster until filled, but in no instance longer than ten (10) calendar days after successful completion of Phase II C for all regulated abatement work areas at the site. Procedures for hauling and disposal shall comply with 40 CFR 61 Subpart M, Federal Emission Standards and all other applicable state, regional, and local government laws, codes, rules, regulations and standards, including the requirements of 6NYCRR Part 364 Waste Transporter Permits pursuant to Article 27, Title 3 Environmental Conservation Law, New York State.
4. Vehicles hauling asbestos waste materials shall be covered to prevent releases of asbestos in route to the disposal site. Waste disposal sites for asbestos materials shall be in accordance with 40 CFR 61.25, Waste Disposal Sites. Provide written

evidence that the site is approved for asbestos disposal by the EPA, State, or local regulatory agency. A receipt designating the number of bags or cubic yard(s) of asbestos waste accepted by the site shall be provided to THE OWNER's Representative. Assure the presence of the Project Monitor when bags are removed from the Work Site(s) and provide a daily tally. Disposable full body protective suits and appropriate respirators shall be made available to the Project Monitor during the bag removal activities.

5. All transported and disposed asbestos waste shall be properly manifested according to all applicable federal, state and local laws, codes, rules and regulations.
6. Provide original waste manifests and waste shipment records to Owner's Representative and copies to the Project Monitor at the conclusion of the abatement work. Receipt by Owner's Representative of waste manifests and waste shipment records shall be received as a prerequisite for approval of payment by Owner.

3.9 LOSS OF INTEGRITY TO CONTAINMENTS / TENTS

If visible emissions or water leaks are observed outside the work area, or an enclosure collapses, the following steps are required:

- A. Shutdown and seal all HVAC openings with at least six (6) mil plastic sheeting in the affected area.
- B. Isolate contaminated areas by sealing passageways from uncontaminated areas with at least six (6) mil plastic sheeting in the affected area.
- C. Install critical barriers within twenty-five (25) feet of the regulated abatement work area.
- D. Install negative air filtration as if the contaminated area is a regulated abatement work area.
- E. Clean-up shall be accomplished by two cleanings: First cleaning shall involve a gross cleaning of the contamination area and a wet cleaning of the interior of the regulated abatement work area; and after a twelve (12) hour settling period a second cleaning.
- F. Clearance air sampling shall then be performed. Only after satisfactory results may isolation and critical barriers be removed.
- G. At the earliest possible time, the Project Monitor and Owner shall be notified.

3.10 DISMANTLING OF THE REGULATED ABATEMENT WORK AREAS

- A. After satisfactory clearance air results have been obtained, the Project Monitor will conduct a final Walk-thru Inspection of the Work Area.
- B. Upon approval of final inspection by the Project Monitor, those surfaces that were the subject of abatement shall be treated with a light coating of lockdown encapsulant.
- C. After lockdown encapsulation pursuant to ICR 56-9.1(b), regulated abatement work areas shall be dismantled and all isolation and critical barriers removed (see ICR 56-9.3). All debris, residue, tape or foam found behind barriers shall be removed by the Contractor. The Contractor shall then conduct a final inspection of the Regulated Abatement Work Area to certify that the abatement work is complete and no debris/residue remains. This certification shall be documented in the Contractor's Daily Log for each Regulated Abatement Work Area. Only upon this certification may the Contractor remove the decontamination enclosures.

- D. After all other remaining isolation barriers, tools and equipment have been removed from the regulated abatement work area, the remaining decontamination enclosure for the regulated abatement work area shall be dismantled and removed from the work site. All plastic sheeting shall be removed and disposed of as asbestos waste.

END OF SECTION

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of a building or structure.
2. Salvage of selected building components and elements.
3. Repair procedures for selective demolition operations.

B. Related Sections include the following:

1. Division 01 General Requirements for temporary construction and environmental-protection measures for selective demolition operations.
2. Division 01 General Requirements for cutting and patching procedures for selective demolition operations.

1.2 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 Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.4 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

- B. Proposed Dust-Control, Noise-Control and Other Special Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- 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 Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
- D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- E. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.5 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Professional Engineer Qualifications: Comply with Division 01 General Requirements.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 General Requirements.

1.6 PROJECT CONDITIONS

- A. Owner will occupy portions of site and buildings immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 2 weeks' notice to Owner of activities that will affect Owner's operations.
- B. Owner may elect to salvage certain items from areas of construction other than those indicated on Drawings as "salvage" prior to selective demolition operations. Give 2 weeks notice to Owner prior to commencing any selective demolition processes to allow for Owner salvage operations.

- C. Maintain access to existing walkways, roadways, and other adjacent occupied or used facilities.
 - 1. Do not close or obstruct walkways, roadways, or other occupied or used facilities without written permission from authorities having jurisdiction.
- D. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- E. Hazardous Materials: Hazardous materials remediation work will be completed prior to commencement of selective demolition in the areas where hazardous materials are present. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
- F. Storage or sale of removed items or materials on-site will not be permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
- H. Cutting and Patching of Existing Roofing System: Contractors performing cutting and patching of the existing roof membrane shall be certified installers by the existing roof membrane manufacturer for their products. When existing roofing system is still under warranty, coordinate all work on the existing roofing system with manufacturer. All cutting and patching work on roofing system shall be performed in a manner that does not void the warranty

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.

- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. 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 Architect.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
 - 1. Provide at least 2 weeks' notice to Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
 - 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - 4. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

- A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
- C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent site improvements, structures and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Provide special protection measures as required by Owner.
- D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects
- E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
- F. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Cleaning: 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.

3.5 SELECTIVE DEMOLITION

- 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 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.
 - 9. Dispose of demolished items and materials promptly.
 - 10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- B. Removed and Salvaged Items: Comply with the following:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

- C. Removed and Reinstalled Items: Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. 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. Salvage items indicated on the Drawings as "salvage".
- E. Existing Facilities: Comply with Owner's requirements for using and protecting elevators, stairs, walkways, building entries, and other building facilities during selective demolition operations.
- F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, 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.
- G. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- H. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- I. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- J. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.
- 3.6 PATCHING AND REPAIRS
- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 01 Section "Cutting and Patching."
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

- D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION 024119

SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes hydraulic-cement-based underlayment for use below interior floor coverings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.
- C. Manufacturer Certificates: Signed by manufacturers of both underlayment and floor covering system certifying that products are compatible.
- D. Qualification Data: For Installer.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of both underlayment and floor covering system certify in writing that products are compatible.
- C. Mockups: Apply hydraulic-cement-based underlayment mockups to demonstrate surface finish, bonding, texture, tolerances, and standard of workmanship.
 - 1. Apply mockups approximately 100 sq. ft. (9 sq. m) in area in location indicated or, if not indicated, as directed by Architect.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 00.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature and humidity, ventilation, and other conditions affecting underlayment performance.
 - 1. Place hydraulic-cement-based underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

1.6 COORDINATION

- A. Coordinate application of underlayment with requirements of floor covering products, including adhesives, specified in Division 09 Sections, to ensure compatibility of products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Ardex, Inc.; K-15 Self-Leveling Underlayment Concrete.
 - 2. Dayton Superior Specialty Chemical Corp.; Level Layer I
 - 3. Mapei Corporation; Ultraplan I Plus

2.2 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

- A. Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thicknesses of 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations. Product shall also be capable of being poured/pumped monolithically (rather than room-by-room).
 - 1. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
 - 2. Compressive Strength: Not less than 4100 psi (28 MPa) at 28 days when tested according to ASTM C 109/C 109M.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.
 - a. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required
 - 4. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).
- B. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance.

1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond. Perform moisture tests recommended by manufacturer and as follows.
1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m) in 24 hours.
 2. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have relative humidity level measurement acceptable to manufacturer.
- C. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.
- D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
 4. Install perimeter isolation strip along the base of partitions prior to installation of topping. Cut isolation strip flush with finished floor.
 5. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- B. Apply underlayment to produce uniform, level surface.
1. Apply a final layer without aggregate to produce surface.

- 2. Feather edges to match adjacent floor elevations.
 - C. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - D. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
 - E. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.
- 3.4 PROTECTION
- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Loose steel lintels.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for ceiling mounted signage.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Custom fabricated aluminum wall base.
6. Aluminum ladders.
7. Aluminum ships ladders.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.
3. Ladders
4. Ships ladders

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Samples for Initial Selection Purposes: In form of manufacturer's color charts showing full range of colors available for aluminum wall base.

D. Samples for Verification: 12-inch- (300-mm-) long sections of fabricated aluminum wall base with applied finish.

1.3 INFORMATIONAL SUBMITTALS

A. Welding Certificates: Copies of certificates for welding procedures and personnel.

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification..

1.5 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.6 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate color and gloss of factory-applied finish paint for fabricated aluminum wall base with factory finish of aluminum storefront and entrance framing. Color and gloss shall match for wall base and framing.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating.
 - C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads. For exterior installations and where indicated, provide pipe with hot-dip galvanized coating.
 - D. Slotted Channel Framing: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch- (14.3-mm-) wide slotted holes in webs at 2 inches (51 mm) o.c.
 - 1. Width of Channels: 1-5/8 inches (41 mm).
 - 2. Depth of Channels: As indicated.
 - 3. Metal and Thickness: Galvanized steel complying with ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.
 - 4. Finish: Unfinished.
 - E. Malleable-Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).
 - F. Gray-Iron Castings: ASTM A 48, Class 30 (ASTM A 48M, Class 200), unless another class is indicated or required by structural loads.
 - G. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- 2.3 ALUMINUM
- A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
 - B. Extruded Bars, Shapes and Mouldings: ASTM B 221 (ASTM B 221M), alloy 6063-T6 or 6063-T52.
 - C. Castings: ASTM B 26, Almag 35.
- 2.4 PAINT
- A. Shop Primer for Interior Ferrous Metal: Modified oil-alkyd primer, Tnemec 88-559 or 10-1009, or equivalent. Primer shall be compatible with finish paint specified in Section 09900.
 - B. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.
 - C. Factory Applied Finish Paint for Aluminum Wall Base: Provide one of the following, as selected by Architect, to match aluminum wall base on 3rd Floor:

1. Baked-Enamel or Powder-Coat Finish: AAMA 2604. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish. Equivalent of Kawneer Permacoat factory finish.
2. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Equivalent of Kawneer Permadize factory finish.
3. Color and Gloss: Metallic color selected by Architect from manufacturer's full-range, and to match aluminum wall base on the 3rd Floor.

2.5 FASTENERS

- A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls, except as noted below. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
- D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- E. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- H. Remove sharp or rough areas on exposed traffic surfaces.
- I. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.7 WALL BASE

- A. Surface-Mounted, Metal Wall Base: Fabricated from 1-piece, formed or extruded metal with formed edges and turn for toe.
1. Material: Aluminum
 - a. Thickness: 14 gauge (.063").
 - b. Finish: Match aluminum wall base on 3rd Floor.
 - c. Color and Gloss: Match aluminum wall base on 3rd Floor.
 2. Height: 4"
 3. Mounting: Adhered to substrate.

2.8 LOOSE STEEL LINTELS

- A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Weld adjoining members together to form a single unit where indicated.
- C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.
- D. Shop prime and field paint all lintels, leave embedded portions of lintels unpainted.

2.9 ALUMINUM LADDERS

- A. Basis of Design Product: Subject to compliance with requirements, provide Model FL Aluminum Fixed Vertical Ladders by Precision Ladders, LLC. or equal by one of the following:
 - 1. O'Keeffe's Inc.
 - 2. UPNOVR
 - 3. Alaco Ladder Company
- B. Space siderails minimum 24 inches apart unless otherwise indicated.
- C. Siderails: Continuous extruded-aluminum channels, not less than 2-1/2 inches wide, 1-1/16" deep, and 1/8 inch thick.
- D. Rungs: Extruded-aluminum channels, not less than 2-1/4 inches wide, 3/4 inch deep and 1/4 inch thick, with ribbed tread surfaces.
- E. Fit rungs in centerline of siderails and weld. Fasten all ladder components by welding.
- F. Support each ladder at top and bottom and not more than 48 inches o.c. with welded or bolted aluminum brackets.
- G. Ladder Capacity: 1500 lb. loading capacity per rung.
- H. Finish: Mill.
- I. Performance Standard: Units designed and manufactured to meet or exceed ANSI A14.3, OSHA 1910.23, OSHA 1910.28 and OSHA 1910.29.

2.10 ALUMINUM SHIP'S LADDER

- A. Fabricate aluminum ship's ladders of open-type construction with channel stringers, continuous pipe railings, and extruded serrated treads. Provide brackets and fittings for installation
 - 1. Angle of Inclination: 60 degrees.
 - 2. Stringers: 5 inch wide by 2 inch deep by 3/16 inch thick extruded channels. Space stringers 2'-6" apart unless otherwise indicated
 - 3. Handrails: 1-1/4 inches Schedule 40 pipe, both sides.
 - 4. Treads: Extruded serrated treads 5-3/16" wide by 1-1/8 inches deep by 1/8 inch thick, welded and bolted to stringers
 - 5. Finish: Aluminum mill finish.
 - 6. Basis of Design Product: Subject to compliance with requirements, provide Model SL Aluminum Ships Stair by Precision Ladders, LLC. or equal by one of the following:
 - a. O'Keeffe's Inc.

- b. UPNOVR
- c. Alaco Ladder Company

- B. Ladder Capacity: 1000 lb. loading capacity per rung.
- C. Performance Standard: Units designed and manufactured to meet or exceed OSHA 1910.25.
- D. Support each ladder at top and bottom with welded or bolted aluminum brackets.
- E. Provide 42 inch handrail extensions (walk-through) for accessing platforms, landings or elevated work spaces.

2.11 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.
- B. Fabricate units from structural-steel shapes, plates, tubes, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
 - 2. Furnish inserts if units must be installed after concrete is placed.

2.12 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware..
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes indicated as unpainted, and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.
 - 1. Do not paint surfaces to be welded or high-strength bolted with friction-type connections.
 - 2. Apply 2 coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.14 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

END OF SECTION 055000

SECTION 061053 - MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wood blocking, furring, supports, sleepers and nailers.
2. Plywood backing panels.

1.2 DEFINITIONS

A. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority.
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses.

C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Fire-retardant-treated wood.

1.4 QUALITY ASSURANCE

- A. All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) shall contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings..

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Provide dressed lumber, S4S, unless otherwise indicated.
 - 3. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
 - 2. Use treatment that does not promote corrosion of metal fasteners.
 - 3. Use Exterior type for exterior locations and where indicated.
 - 4. Use Interior Type A High Temperature (HT), unless otherwise indicated.

2.3 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.

3. Furring.
4. Sleepers

B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and the following species: Mixed southern pine; SPIB.

C. For concealed boards, provide lumber with 19 percent maximum moisture content of the following species and grades:

1. Spruce-pine-fir (south) or Spruce-pine-fir, Construction or 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.

2.4 PLYWOOD PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch (12.7 mm) thick.

1. Paint before mounting of equipment. Do not paint over the fire-retardant marking.

B. Miscellaneous Concealed Plywood: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch (13 mm).

1. Provide fire-retardant-treated panels for interior locations unless indicated.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners:

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for

accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

- C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- E. Use fasteners of appropriate type and length. Pre-drill members when necessary to avoid splitting wood.

3.2 PANEL PRODUCT INSTALLATION

- A. Fastening Methods: Fasten panels as indicated below:
 - 1. Plywood Backing Panels: Screw to supports.
 - 2. Miscellaneous Concealed Plywood Panels: Screw to supports.

3.3 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

END OF SECTION 061053

SECTION 066116 - SOLID SURFACE MATERIAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes solid surface material fabricated into the following:
 - 1. Solid surface material wall cladding.
- B. Related Sections include the following:
 - 1. Sealants are specified in Division 07 Section "Sealants."
 - 2. Metal corner guards are specified in Division 10 Section "Wall and Door Protection."
 - 3. Solid surface lavatories are specified in Division 22 Plumbing.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Indicate dimensions, component sizes, fabrication details, edge treatment, attachment provisions, cutouts for insertion of wire management units, and coordination requirements with adjacent work.
- B. Samples: Submit minimum 6" x 6" samples of selected colors and patterns. Where color is not specified, provide full range of manufacturer's available color samples for selection by Architect.
- C. Product Data: Indicate product description, fabrication information, and compliance with specified performance requirements.

1.3 INFORMATIONAL SUBMITTALS

- A. Maintenance Data: Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in project closeout documents.
- B. Fabricator's Certificate: Submit certificate from manufacturer stating that fabricator is certified by manufacturer for this work.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced and licensed by manufacturer for production of solid surface fabrications similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.
- B. Fire-Test-Response Characteristics: Provide materials with surface-burning characteristics as indicated below, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Flame Spread: 25 or less.
2. Smoke Developed: 450 or less

1.5 JOB CONDITIONS

- A. Deliver no components to project site until areas are ready for installation. Store indoors.
- B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.
- C. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, to ensure proper fitting of work. However, allow for adjustments where taking of field measurements before fabrication might delay work.
- D. Coordination: Furnish inserts and anchorages which must be built into other work. Coordinate delivery with other work to avoid delay.

1.6 WARRANTY

- A. General: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Provide manufacturer's warranty. The manufacturer warrants to the original purchases for commercial or residential use that the manufacturer will at its option repair or replace, without charge, such product if it fails due to a manufacturing defect during the first 10 years after initial installation. This includes reasonable labor charges needed to repair or replace the product covered hereunder. This warrantee applies to solid polymer products that are used and maintained in the manner recommended by the manufacturer. The warrantee does not cover damage caused by:
 1. Physical abuse, damage from excessive heat, or breakage not due to a defect in the manufacturer of the material.
 2. Failure of any adhesive, caulk, or other accessory, or failure of any caulked or filled joint or seam.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturers: Provide Basis of Design Products or equal product of one of the following:
 1. AristechAcrylics, LLC.
 2. DuPont Polymers
 3. Formica

4. Krypton Solid Surface; Porcelanosa group

2.2 MATERIALS

- A. General: Provide materials which have been selected for surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.
- B. Solid Surface Material (SS-1 and SS-2): Non-porous, homogeneous material maintaining the same composition throughout with a composition of acrylic polymer, aluminum trihydrate filler and pigment; not coated, laminated or of composite construction; meeting following criteria:
 1. Thickness: 1/2 inch (12 mm).
 2. Colors and Patterns: As scheduled.
 3. Finish: Semigloss.
 4. Basis of Design Product:
 - a. SS-1: Krypton Terrazzo Series by Krypton Solid Surface; Porcelanosa group, or equal.
 - b. SS-2: Krypton Royal+ Series by Krypton Solid Surface; Porcelanosa group, or equal

2.3 MISCELLANEOUS MATERIALS

- A. Joint Adhesive: Manufacturer's standard two-part adhesive kit to create inconspicuous, non-porous joints with chemical bonding.
- B. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.
- C. Metal Edge Trim: Finishing and edge-protection profile for the outside corners of panel surfaces, with a trapezoid-perforated anchoring leg that is secured to the substrate and a reveal that forms a square outer corner along the surface edge. Provide inside and outside corners as required for complete installation.
 1. Material: Aluminum, in finish to match aluminum baseboards.
 2. Size: As required for each installation condition.
 3. Basis of Design Product: QUADEC by Schluter, or equal.

2.4 FABRICATION

- A. General: All fabrications shall be made using solid surface material. Fabrications shall be adhesively jointed with no exposed seams and having edge details as indicated on drawings. No exposed fasteners shall be allowed.
- B. Factory fabricate components into single unit to sizes and shapes indicated, in accordance with approved shop drawings.

- C. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints.
- D. Provide factory cutouts for devices and accessories as indicated on the drawings.
- E. Cut and finish component edges with clean, sharp returns. Route radii and contours to template. Repair or reject defective and inaccurate work.
- F. Edges: Eased, unless otherwise indicated.
- G. Allowable Tolerances
 - 1. Variation in component size: $\pm 1/8"$.
 - 2. Location of openings: $\pm 1/8"$ from indicated location.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surface to receive work and conditions under which work will be installed. Do not proceed with work until all unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install components plumb and level, scribed to adjacent finishes, in accordance with approved shop drawings and product installation data.
- B. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.
- C. Adhere wall panels to substrate using manufacturer's recommended adhesive.
- D. Install metal edge trim as per manufacturer's directions.

3.3 ADJUST AND CLEAN

- A. Clean exposed surfaces using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period. Repair work or replace damaged work that cannot be repaired as required.
- B. Keep components and hands clean during installation. Remove adhesives, sealants, and other stains. Replace stained components.

END OF SECTION 066116

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Spray foam insulation, closed cell type.
2. Intumescent fire-protective coating for spray polyurethane foam insulation.
3. Insulation accessories.

B. Related Sections:

1. Section 092900 "Gypsum Board" for installation of acoustical blankets in metal-framed assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include product data that indicates the intumescent spray is part of a tested Alternative Thermal Barrier Assembly with the spray polyurethane foam insulation used in the Work.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For spray foam and intumescent fire-protective coating Installers.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

C. Research/Evaluation Reports: For foam-plastic insulation and intumescent fire-protective coating, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Spray Foam Applicator: An authorized representative who is trained and approved by spray foam manufacturer.

C. Environmental Conditions: Apply products only within temperature and humidity limits established by materials' manufacturers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Store spray foam and intumescent fire-protective coating materials in an area protected from freezing and overheating damage and in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SPRAY FOAM INSULATION

- A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 2.0 lb/cu. ft. and minimum aged R-value of 7.0 deg F x h x sq. ft./Btu at 75 deg F at 1 inch thickness, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84, HFO blown SPF system.
 - 1. Compressive Strength: Minimum 36 psi
 - 2. Thickness: As required to meet the R-values indicated on Drawings.
 - 3. Sustainability: Zero Ozone Depletion Potential (ODP) and less than 2 Global Warming Potential (GWP)
 - 4. Basis of Design Product: Provide JM Corbond IV by Johns Manville, a Berkshire Hathaway Company, or comparable product by one of the following:
 - a. DuPont (formerly Dow).
 - b. Henry Company.
 - c. Icynene Inc

2.2 INTUMESCENT FIRE-PROTECTIVE COATING FOR SPRAY POLYURETHANE FOAM INSULATION

- A. Intumescent Fire-Protective Coating: Water-based thin film spray intumescent coating for interior spaces where spray polyurethane foam is installed. Coating shall have an ASTM E84 Class A/Class 1 flame spread and smoke developed rating and shall qualify as a component in an Alternative Thermal Barrier Assembly when installed with the spray polyurethane foam insulation specified.
 - 1. Thickness: For the specified spray foam insulation, 14 mils wet. Adjust as required if alternative spray foam is provided (other than Basis of Design Product specified above).
 - 2. Color: White.
 - 3. Basis of Design Product: Plus ThB by No-Burn, Inc., or equal.

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by spray foam insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.
- B. Priming: Prime substrates where recommended by spray foam insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION OF SPRAY FOAM INSULATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- D. Do not apply insulation within 3 inches (76 mm) of heat-emitting devices or where temperature exceeds 200 deg F (93 deg C) per ASTM C411, or in accordance with applicable codes.

3.3 INSTALLATION OF INTUMESCENT FIRE-PROTECTIVE COATING FOR SPRAY POLYURETHANE FOAM INSULATION

- A. Spray apply in accordance with manufacturer's written instructions.
- B. Maintain thickness of coating as required to produce assembly complying with published test results when applied to spray foam insulation.

3.4 PROTECTION

- A. Protect installed insulation and intumescent coating from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 072100

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in fire-resistance-rate horizontal assemblies.
3. Penetrations in non-fire-resistance-rate horizontal assemblies.
4. Penetrations in smoke barriers, smoke partitions and smoke tight partitions.

B. Related Sections:

1. Section 078446 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include

having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."
- C. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Penetration Firestop Systems specified in the Schedule in Part - 3 include:
 - a. Fire Barrier Products, 3M Fire Protection Products
 - b. RectorSeal Corporation.
 - 2. Subject to compliance with specified requirements, provide Penetration Firestop Systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory (BXRH), by one of the following:
 - a. Hilti, Inc.
 - b. Nelson Firestop Products.
 - c. RectorSeal Corporation.
 - d. Specified Technologies Inc.
 - e. 3M Fire Protection Products.
 - f. Wiremold/Legrand

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Horizontal assemblies include floors and floor/ceiling assemblies.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.

- E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.

3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. For penetrations in non-fire rated horizontal assemblies, smoke barriers, smoke partitions and smoke tight partitions, provide systems tested for 1 hour unless otherwise noted.
- C. Basis of Design Assemblies: Subject to compliance with requirements, provide the design indicated below or a comparable UL design by one of manufacturer's listed in Part 2 above.
 1. Schedule of construction components, type of penetrant, and U.L. Penetration Firestop Systems include, but are not limited to the following:
 2. Schedule of construction components, type of penetrant, and U.L. Penetration Firestop Systems include, but are not limited to the following:

	PENETRANT
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	Metal Conduit	Cable Tray⁴	Cables	Non-Insul. Metal Pipe	Insul. Pipe	FR Polypropylene Pipe	Insul. Metal Duct
GWB Stud Wall, or Shaft Wall up to 2 Hr Rating	W-L-1001	W-L-4004	W-L-3001	W-L-1001	W-L-5011	W-L-2002	W-L-7006 ³
CMU Wall up to 2 Hr Rating	C-AJ-1044	C-AJ-4003	C-AJ-3030	C-AJ-1044	C-AJ-5001	C-AJ-2001	C-AJ-7003 ³ , 7016 ³
Concrete Floor / Metal Deck 1 Hr Rated F and T-Rating²	C-AJ-1008	N/A	C-AJ-3029	C-AJ-1008	C-AJ-5002	F-A-2002	C-AJ-7009 ⁵
Concrete Floor / Metal Deck 2 Hr Rated F and T-Rating²	C-AJ-1008	N/A	C-AJ-3029	C-AJ-1008	C-AJ-5060	F-A-2002	N/A
Concrete Floor / Metal Deck up to 2 Hr F Rated¹	F-A-1002	N/A	C-AJ-3030	C-AJ-1044	C-AJ-5001	F-A-2002	N/A

KEY TO NOTES

1. Penetration within wall cavity.
2. Penetration that does not fall within wall cavity, T-Rating required.
3. Up to 1 hour rating, submit engineered judgement firestopping system for this combination of penetrant, wall/floor assembly, and fire rating. Install fire dampers in 2-hour walls in accordance with manufacturer's instructions and testing agency requirements.
4. Where cable tray extends through wall.
5. For floor penetrations not enclosed above and below the floor with shaft wall.

D. Membrane Penetrations:

1. Firestop membrane penetrations by cables, pipes and conduit similar to through wall penetrations.
 2. Provide putty pad box wrap firestopping for membrane penetrations in rated walls for electrical back boxes over 16 sq. inches, where any back boxes are located within 24 inches horizontal of another back box, or when total area of back boxes exceeds 100 sq in. in 100 sq. ft. of wall area.
- E. Where another type of construction or penetrant is encountered, or if field conditions vary from those described in the U.L. System listed (i.e. annular space is greater/smaller, insulation type varies, etc.), provide firestopping systems which are appropriate, and U.L. tested, for that condition.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

B. Related Sections:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint

system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
 - 1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."

- C. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall

accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Grace Construction Products.
 - b. Hilti, Inc.
 - c. RectorSeal Corporation.
 - d. Specified Technologies Inc.
 - e. 3M Fire Protection Products.
 - f. Tremco, Inc.; Tremco Fire Protection Systems Group.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa) or ASTM E 2307.
1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Grace Construction Products.
 - b. Hilti, Inc.
 - c. Johns Manville.
 - d. RectorSeal Corporation.
 - e. Specified Technologies Inc.
 - f. 3M Fire Protection Products.
 - g. Tremco, Inc.; Tremco Fire Protection Systems Group.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.
1. L-Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.
 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Grace Construction Products.
 - b. Hilti, Inc.
 - c. Johns Manville.
 - d. RectorSeal Corporation.
 - e. Specified Technologies Inc.

- f. 3M Fire Protection Products.
 - g. Tremco, Inc.; Tremco Fire Protection Systems Group.
- E. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
- 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- G. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work

and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

- B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.
- C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 FIRE-RESISTIVE JOINT SYSTEM / FIRESTOP JOINT SYSTEM SCHEDULE

- A. Where UL-classified firestop joint systems are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.

Firestop Joint System Location	Basis-of-Design	Assembly Rating	Nominal Joint Width	Movement Capabilities ²
Floor-to-Wall				
Rated concrete masonry wall construction intersection with adjacent floor construction	FW-D-1012, FW-D-1013	1 hour or 2 hours ¹	As indicated, or required by tested assembly	Class II
Head-of-Wall				
Rated gypsum wall construction intersection with steel floor deck above	HW-D-0087, or HW-D-0089	1 hour or 2 hours ¹	As indicated, or required by tested assembly	Class II or III,
Rated gypsum wall construction intersection with concrete floor deck above	HW-D-0083, HW-D-209	1 hour or 2 hours ¹	As indicated, or required by tested assembly	Class II

Rated concrete masonry wall construction intersection with steel floor deck above	HW-D-0081, or HW-D-0098	1 hour or 2 hours ¹	As indicated, or required by tested assembly	Class II
Rated concrete masonry wall construction intersection with concrete floor deck above	HW-D-0268, HW-D-0097	1 hour or 2 hours ¹	As indicated, or required by tested assembly	Class II
Bottom-of-Wall				
Rated gypsum wall construction intersection with concrete floor	BW-S-0002	1 hour or 2 hours ¹	As indicated, or required by tested assembly	Static

1. Rating to match wall construction.
2. Class UL2079

- B. Where another type of construction is encountered, or if field conditions vary from those described in the U.L. System listed (i.e. annular space is greater/smaller, insulation type varies, etc.), provide firestopping systems which are appropriate, and U.L. tested, for that condition.

END OF SECTION 078446

ATTACHMENT: FIRESTOP JOINT SYSTEMS SUBMITTAL SHEET

3.8 FIRESTOP JOINT SYSTEMS SUBMITTAL SHEET

A. **HEAD-OF-WALL FIRESTOPPING:** Fill in the U.L. Design number and attach copy of U.L. Test. Insert n/a if condition is not applicable.

1. Gypsum wall construction intersection with floor deck above: _____.
Gypsum wall construction intersection with roof deck above: _____.
2. Concrete masonry wall construction intersection with floor deck above: _____.
3. Concrete masonry wall construction intersection with roof deck above: _____.

B. **FLOOR-TO-WALL FIRESTOPPING:** Fill in the U.L. Design number and attach copy of U.L. Test. Insert n/a if condition is not applicable.

1. Concrete masonry wall construction intersection with adjacent floor construction: _____.

C. **BOTTOM-OF-WALL FIRESTOPPING:** Fill in the U.L. Design number and attach copy of U.L. Test. Insert n/a if condition is not applicable.

1. Gypsum wall construction intersection with floor deck: _____. Gypsum wall construction intersection with roof deck above: _____.
2. Concrete masonry wall construction intersection with floor _____.
3. Concrete masonry wall construction intersection with roof deck above: _____.

D. **CURTAIN WALL FIRESTOPPING:** Fill in the design number and copy test. Insert n/a if condition is not applicable.

1. Aluminum mullion and glass spandrel panel curtainwall intersection with adjacent floor construction:
2. Gypsum sheathed curtainwall intersection with adjacent floor construction: _____.

E. **OTHER:** Where another type of construction or penetrant is encountered, attach a separate sheet listing each condition and attach copy of the U.L. Test.

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes joint sealants for the following locations:

1. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Perimeter joints between interior wall surfaces and frames of interior doors, and windows.
 - b. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - c. Tile control and expansion joints
 - d. Openings and joints in sound-rated partitions.
 - e. Provide a neat uniform seal at all wall penetrations in spaces without ceilings.
 - f. Other joints as indicated.
2. Interior joints in the following horizontal traffic surfaces:
 - a. Tile control and expansion joints
 - b. Other joints as indicated.

B. Related Sections include the following:

1. Sealants used in glazing are specified in Division 08 "Glazing."
2. Coordinate work of this section with all sections referencing it.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.
- C. Samples for verification purposes of each type and color of joint sealant required. Install joint sealant samples in 1/2-inch (13-mm)) wide joints formed between two 6-inch (150-

mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.
- B. Qualification data complying with requirements specified in "Quality Assurance" article. Include list of completed projects with project names addresses, names of Architects and Owners, plus other information specified.
- C. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.
- D. Product test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.
- E. Preconstruction field test reports indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates.
- F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an installer who has successfully completed at least three (3) joint sealer applications similar in type and size to that of this project within the last five (5) years. All workers used for work of this Section shall be experienced in the techniques of sealant application and shall be completely familiar with the published recommendations of the manufacturer of the joint sealant materials being used.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Preconstruction Field Testing: Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows:
 - 1. Locate test joints where indicated or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of non-elastomeric sealant and joint substrate indicated.
 - 3. Notify Architect one week in advance of the dates and times when mock-ups will be erected.
 - 4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.

5. Test Method: Test joint sealants by hand pull method described below:
 - a. Install joint sealants in 60 inches (1500 mm)) joint lengths using same materials and methods for joint preparation and joint sealant installation required for completed Work. Allow sealants to cure fully before testing.
 - b. Make knife cuts horizontally from one side of joint to the other followed by 2 vertical cuts approximately 2 inches (50 mm) long at side of joint and meeting horizontal cut at top of 2-inch (50-mm) cuts. Place a mark 1 inch (25 mm) from top of 2-inch (50-mm) piece.
 - c. Use fingers to grasp 2-inch (50-mm) piece of sealant just above 1-inch (25-mm) mark; pull firmly down at a 90-degree angle or more while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
 6. Maintain a record of all test results in the form of a tabular log of all joint sealant applications during preconstruction field testing. Include columns for date, temperature, weather conditions and locations of tests.
 7. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
 8. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.
- D. Field-Constructed Mock-Ups: Prior to installation of joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution:
1. Joints in field-constructed mock-ups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants specified in this Section.
- E. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of the Division 01 Section covering this activity.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
 - B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 deg F (4 deg C).
 - 2. When joint substrates are wet.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.8 COORDINATION

- A. Coordinate the work with all sections referencing this section.

1.9 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Extra Materials: Furnished from same production run as sealants installed. Package materials with protective covering and identify with labels describing contents. Deliver extra materials to Owner.
 - 1. Furnish 2 tubes of each color of sealant provided in the Work

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors: Provide color of exposed joint sealants to comply with the following:
 - 1. Provide selections made by Architect from manufacturer's standards or custom colors to match Architect's samples, as directed by Architect.

- C. **Additional Movement Capability:** Where additional movement capability is specified, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for Uses indicated.
- D. **VOC Content of Interior Sealants:** Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- E. **Stain-Test-Response Characteristics:** Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.2 LATEX JOINT SEALANT

- A. **Acrylic-Emulsion Sealant:** Manufacturer's standard, one part, nonsag, mildew-resistant, paintable latex acrylic-emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior locations involving joint movement of not more than plus or minus 5 percent.
 - 1. **Available Products:** Subject to compliance with requirements, latex joint sealants that may be incorporated in the Work include, but are not limited to, the following:
 - a. AC-20; Pecora Corporation.
 - b. Tremflex 834; Tremco.
 - c. ALEX PLUS; DAP .
- B. **Uses:** General interior use, paintable..

2.3 MILDEW-RESISTANT SILICONE JOINT SEALANT

- A. **Single-Component Mildew-Resistant Silicone Sealant:** Manufacturer's standard, non-modified, one-part, silicone sealant; complying with ASTM C 920, Type S, Grade NS, Class 25, Uses NT, G, A, and, as applicable to non-porous joint substrates indicated, O. Formulate sealant with fungicide and specifically intended for sealing interior joints with nonporous substrates and subject to in-service exposure to conditions of high humidity and temperature extremes.
 - 1. **Available Products:** Subject to compliance with requirements, silicone joint sealants that may be incorporated in the Work include, but are not limited to, the following:
 - a. 786 Mildew Resistant; Dow Corning.
 - b. Sanitary 1700; GE Silicones.
 - c. 898 Silicone Sanitary Sealant; Pecora Corporation.
 - d. Tremsil 600 White; Tremco.

- B. Uses: Interior use in wet locations, and all toilet and shower rooms.

2.4 POURABLE URETHANE JOINT SEALANT

- A. Multicomponent Pourable Urethane Sealant: Manufacturer's standard, non-modified, two-part, urethane sealant; complying with ASTM C 920, Type M, Grade P, Class 25, Uses T, M, A and, as applicable to joint substrates indicated, O.

- 1. Available Products: Subject to compliance with requirements, urethane joint sealants that may be incorporated in the Work include, but are not limited to, the following:
 - a. NR-200 Urexpan, Pecora Corporation
 - b. Sikaflex 2c SL, Sika Corporation
 - c. Masterseal SL 2; Master Builders Solutions Div., BASF

- B. Uses: Interior or exterior use for level pavement or slab joints.

2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant: Non-sag (gun grade), non-flammable, latex-based sealant designed to limit sound transmission through interior STC-rated partitions. Sealant remains flexible and adhered to metal, wood, plaster, gypsum, and concrete after drying.

- 1. Maintains the STC rating of partitions with intersections and penetrations sealed with product: Tested by independent, accredited, NVLAP facility according to ASTM E 90.
- 2. Products: Provide one of the following:
 - a. QuietZone Acoustic Sealant by Owens Corning.
 - b. OSI GreenSeries SC-175 Draft & Acoustical Sound Sealant by Henkel Corporation
 - c. Pecora AIS-919: Acoustical and Insulation Latex Sealant by Pecora Corporation
 - d. Smoke 'N' Sound Acoustical Sealant by Specified Technologies Inc.

- B. Uses: At penetrations through and intersections of sound-rated wall, floor and ceiling assemblies in order to preserve their ability to reduce airborne sound impact noise transmission.

2.6 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape,

and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
 2. Manufacturer: Provide Cera-Rod manufactured by W.R. Meadows, Inc., or equivalent.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 3. Remove laitance and form release agents from concrete.
 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. **Joint Priming:** Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. **Masking Tape:** Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. **General:** Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. **Sealant Installation Standard:** Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. **Installation of Sealant Backings:** Install sealant backings to comply with the following requirements:
1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint fillers.
 - b. Do not stretch, twist, puncture, or tear joint fillers.
 - c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.
 2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.
- D. **Installation of Sealants:** Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths

relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

- E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - 1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.
 - 2. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200



George Latimer, Westchester County Executive

**General Requirements and Proposals
Information for Bidders
General and Special Clauses
Technical Specifications**

**LOW RISE BUILDING RENOVATIONS AND
HVAC IMPROVEMENTS - PHASE II
110 DR. MARTIN LUTHER KING, JR. BOULEVARD
WHITE PLAINS, NEW YORK**

VOLUME 2 OF 2

Contract No. 20-502

Bid Opening: February 14, 2024

By Bidder (Please Print)

Firm/Business Name: _____

Address: _____

For Official Use Only

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

Division of Engineering

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263111	ADDRESSABLE FIRE ALARM SYSTEM

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SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall access doors and frames for interior locations.
2. Fire-rated wall access doors and frames for interior locations
3. Ceiling access doors and frames for interior locations.
4. Fire-rated ceiling access doors and frames for interior locations.

- B. Locations and Quantities of Access Doors: Not all access doors are shown on the Drawings. It is the intent of this section that access doors be provided wherever access is required for operation and maintenance of concealed equipment, dampers, valves, controls or similar devices.

- C. Cylinders for access doors are specified in Division 08 Section "Door Hardware."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

- C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.

- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.3 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 PRODUCTS, GENERAL

- A. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

2.3 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babcock-Davis.
2. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
3. Karp Associates, Inc.
4. Larsen's Manufacturing Company.
5. Milcor Inc.
6. Nystrom, Inc.

- B. Flush Access Doors, with Exposed Trim, for CMU Surfaces: Units consisting of frame with exposed trim, door, hardware, and complying with the following requirements

1. Basis-of-Design Product: Karp Model DSC-214M, Universal Flush Access Door.
2. Assembly Description: Fabricate door to fit flush to frame. Provide flange integral with frame, 3/4 inch (19 mm) wide, overlapping surrounding finished surface.
3. Locations: Provide at non-rated concrete block walls.
4. Uncoated Steel Sheet for Door: Nominal 0.074 inch (1.9 mm), 14 gage.
 - a. Finish: Factory prime.
5. Stainless-Steel Sheet for Door for Toilet Rooms, Shower Rooms, and Other Wet Areas: Nominal 0.074 inch (1.9 mm), 14 gage; No. 4 finish.
6. Frame Material: Nominal 0.060 inch (1.52 mm), 16 gage
7. Hinges: Concealed continuous piano hinge.
8. Latches: Self-latching key-operated bolt type, with interior release; for locking.

- C. Trimless, Flush Access Doors for Gypsum Board Surfaces: Units consisting of frame, concealed edge trim, door, hardware, and complying with the following requirements:

1. Basis-of-Design Product: Karp KDW for drywall

2. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
 3. Locations: Provide at non-rated gypsum board walls and ceilings.
 4. Uncoated Steel Sheet for Door: Nominal 0.074 inch (1.9 mm), 14 gage.
 - a. Finish: Factory prime.
 5. Stainless-Steel Sheet for Door for Toilet Rooms, Shower Rooms, and Other Wet Areas: Nominal 0.074 inch (1.9 mm), 14 gage; No. 4 finish.
 6. Frame Material: Nominal 0.060 inch (1.52 mm), 16 gage.
 7. Hinges: Concealed continuous piano hinge.
 8. Latches: Self-latching key-operated bolt type, with interior release; for locking.
- D. Recessed Doors for Acoustical Ceiling Tiles: Units consisting of frame with no exposed trim, recessed door to receive tile, hardware, and complying with the following requirements.
1. Basis-of-Design Product: Karp, Model DSC-210, Recessed Acoustical Ceiling Tile Access Doors.
 2. Locations: Provide at non-rated acoustical ceilings tiles.
 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage thick steel sheet; recessed 1-inch (25.4 mm).
 - a. Finish: Factory prime.
 4. Stainless-Steel Sheet for Door for Toilet Rooms, Shower Rooms, and Other Wet Areas: Nominal 0.060 inch (1.52 mm), 16 gage; No. 4 finish.
 5. Frame Material: Nominal 0.074 inch (1.9 mm), 14 gage.
 6. Hinges: Concealed, pivoting-rod type.
 7. Latches: Self-latching key-operated bolt type, with interior release; for locking.
- E. Insulated, Fire-Rated Access Doors for Drywall Walls and Ceilings: Units consisting of frame with gypsum board bead concealed edge trim, self-latching insulated door, and hardware, and complying with the following requirements:
1. Basis-of-Design Product: Karp, Model KRP-350FR, Insulated Fire Rated Access Door, with Drywall Bead, for Walls and Ceilings.
 2. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release.
 3. Locations: Provide at rated gypsum board walls and ceilings.
 4. Fire-Resistance Ratings:
 - a. Walls: 1-1/2 hours.
 - b. Ceilings: 3 hours.
 5. Uncoated Steel Sheet for Door: 20 ga., 0.0359-inch- (0.91-mm-) thick steel sheet, welded pan type, filled with 2-inch (50 mm) thick fire-rated mineral-fiber insulation.
 - a. Finish: Factory prime.
 6. Stainless-Steel Sheet for Door for Toilet Rooms, Shower Rooms, and Other Wet Areas: Same gage and style as steel door; with No. 4 finish.

7. Frame Material: 16 ga., 0.0598-inch- (1.52-mm-) thick steel sheet, 1-inch (25.4 mm) wide, surrounded by galvanized drywall bead.
8. Hinges: Concealed continuous piano hinge.
9. Hardware: Self-latching key-operated bolt type, with interior release; for locking.

F. Insulated, Fire-Rated Access Doors for CMU Walls: Units consisting of frame with exposed edge trim, self-latching insulated door, and hardware, and complying with the following requirements:

1. Basis-of-Design Product: Karp, Model KRP-150FR, Insulated Fire Rated Access Door, with Exposed Flange, for Walls and Ceilings.
2. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide flange integral with frame, 1 inch (25 mm) wide, overlapping surrounding finished surface. Provide self-latching door with automatic closer and interior latch release.
3. Locations: Provide at rated concrete block walls.
4. Fire-Resistance Ratings:
 - a. Walls: 1-1/2 hours.
5. Uncoated Steel Sheet for Door: 20 ga., 0.0359-inch- (0.91-mm-) thick steel sheet, welded pan type, filled with 2-inch (50 mm) thick fire-rated mineral-fiber insulation.
 - a. Finish: Factory prime.
6. Stainless-Steel Sheet for Door for Toilet Rooms, Shower Rooms, and Other Wet Areas: Same gage and style as steel door; with No. 4 finish.
7. Frame Material: 16 ga., 0.0598-inch- (1.52-mm-) thick steel sheet, 1-inch (25.4 mm) wide exposed trim.
8. Hinges: Concealed continuous piano hinge.
9. Hardware: Self-latching key-operated bolt type, with interior release; for locking.

G. Hardware:

1. Lock: Cylinder, keyed alike for project
2. Lock for Fire Rated Access Doors: Rim cylinder.
 - a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

- D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines or blend into finish.
- E. Frame Anchors: Same type as door face.
- F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 - 3. Provide mounting holes in frames for attachment of units to metal or wood framing.
 - 4. Provide mounting holes in frame for attachment of masonry anchors.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. Non-Rated Doors: For cylinder locks, furnish two keys per lock and key all locks alike.
 - 2. Fire-Rated Doors: Cylinder and keys are specified in Section 087100 "Door Hardware."

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 - 1. Factory Prime: Apply manufacturer's standard, VOC-free, electrostatic-applied powder coat finish immediately after surface preparation and pretreatment.
- E. Stainless-Steel Finishes:
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - c. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
 - 1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.0296 inch, 20 ga. (0.752 mm).
 - b. Depth: As scheduled on Drawings for each location.
- C. Slip-Type Head Joints: Provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs

friction fit into top runner and with continuous cold rolled channel bridging attached to each stud located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) ClarkDietrich; MaxTrak Slotted Deflection Track
 - 2) Steel Network Inc. (The); VertiClip SLD Series.
 - 3) Telling Industries; True-Action™ Slotted Track

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.033 inch, 20 ga. (0.84 mm).

E. Cold-Rolled Channel Bridging and Bracing: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 1-1/2 inches (38 mm) unless otherwise indicated.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Postinstalled, chemical anchor or postinstalled, expansion anchor.
2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

- D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: 1-1/2 inches (38 mm) unless otherwise indicated on Drawings.
- F. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 - 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.018 inch, 25 ga. (0.45 mm).
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for

anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.
- E. Cutting, Notching and Boring Holes in Nonstructural Steel Wall Framing:
 1. Flanges and lips of nonstructural steel wall studs shall not be cut or notched.
 2. Holes in webs of nonstructural steel wall studs shall be permitted along the centerline of the web of the framing member, shall not exceed 1-1/2 inches (38 mm) in width or 4 inches (102 mm) in length, and the holes shall not be spaced less than 24 inches (610 mm) center to center from another hole or less than 10 inches (254 mm) from the bearing end.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install studs so flanges within framing system point in same direction.
 1. Space studs at 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.

- b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

- C. Install steel studs used as furring with clip angles at midpoint of wall span. Install additional clips to limit deflection to L/240 for walls finished with gypsum wall board and L/360 for walls finished with tile or plaster when subject to 5 psf (239 Pa) lateral load.
- D. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Sound-attenuation blankets
- B. Related Requirements:
 - 1. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.3 QUALITY ASSURANCE

- A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corp.
 - 2. Georgia-Pacific Gypsum LLC.
 - 3. Lafarge North America Inc.
 - 4. National Gypsum Company.
 - 5. USG Corporation.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Where drawings indicate regular type 5/8 inch, provide 5/8 inch Type X.
 - 3. Long Edges: Tapered.
- C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch .
 - 2. Long Edges: Tapered.
- D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces, in 5/8 inch thickness unless otherwise indicated, with tapered edges; panels shall be classified as Type X
 - 1.
 - 2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - 3. Products: Subject to compliance with requirements, provide one of the following or equal:
 - a. National Gypsum Company; Type XP/PR
 - b. United States Gypsum Co.; Mold Tough

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized-coated steel sheet or rolled zinc
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. Expansion (control) joint.
 - f. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Columbia Architectural Products, Inc.
 - b. Fry Reglet Corp.
 - c. Gordon, Inc.
 - d. Pittcon Industries.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
 - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified
 - 4. Products:
 - a. Provide Contura curved drywall trim by Gordon Inc. for locations indicated on the Drawings, in sizes required.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use factory mixed drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use factory mixed drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Provide mineral-fiber SAFB where required by the UL assembly.
- E. Acoustical Joint Sealant: As specified in Section 079200 "Joint Sealants"

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Vertical surfaces unless otherwise indicated.
 - 2. Ceiling Type: Ceiling surfaces.
 - 3. Moisture- and Mold-Resistant Type: In bathrooms and toilet rooms.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

1. Install control joints on 30 foot maximum centers, for all partitions, at locations indicated, and as detailed. Align control joints with door frames wherever possible, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.
2. Install control joints at 50 foot maximum centers, with areas not to exceed 2,500 sq. ft. for all ceiling areas, at locations indicated, and as detailed.

- C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Bullnose Bead: Use where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. Curved-Edge Cornerbead: Use at curved openings.

- D. Aluminum Trim: Install in locations indicated on Drawings.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At all panel surfaces that will be exposed to view unless otherwise indicated.
 - 4. Level 5: Provide Level 5 finish at all areas where wall washed lighting is indicated and at surfaces scheduled to receive gloss paint, and elsewhere specifically indicated on Drawings and schedules.

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093100 - CERAMIC TILING**PART 1 - GENERAL****1.1 SUMMARY****A. This Section includes the following:**

1. Porcelain tile
2. Trim and edge accessories.
3. Waterproof membrane for tile installations
4. Stone thresholds.

B. Sealing of expansion, contraction, control, and isolation joints in tile surfaces is specified in Division 07 Section "Joint Sealant."**1.2 ACTION SUBMITTALS****A. Product data for each type of product specified.****B. Samples of each color of tile, marble threshold, or accessory to be provided, for verification purposes.****C. Samples of grout demonstrating full range of colors available, for initial selection purposes.****1.3 INFORMATIONAL SUBMITTALS****A. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, plus other information specified.****1.4 QUALITY ASSURANCE****A. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.****B. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.****C. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.**

- D. Unit Mock-up: Provide mock-up on a board min. 2' x 2' in size, one for each different tile and grout color to be provided in the work; for final approval of grout color before ordering grout.
- E. In-Place Mock-up: Prepare mock-ups of types indicated below following requirements of this section. Reprepare mock-ups as many times as required by Architect until satisfactory result is obtained, as judged solely by Architect. Obtain Architect's approval of visual qualities before proceeding with work. Protect approved mock-ups until all work has been completed. Approved mock-ups will represent the minimum standard of acceptability for each portion of the work.
 - 1. Provide in-place sample minimum 5' x 5' of typical flooring layout for each type of floor tile in area(s) directed by Architect.
 - 2. Provide in-place sample of minimum of 4' x 4' of typical wall tile layout in area directed by Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
- C. Maintain temperatures at 50 deg F (10 deg C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.
- D. Flash patch 100% of the substrate under tile.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturers: The design for each tile type and other material specified is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following manufacturers:
 - 1. Tile:
 - a. American Olean; Div. of Dal-Tile International Corp

- b. Creative Materials Corp.
 - c. Crossville Inc
 - d. Daltile; Div. of Dal-Tile International Inc.
 - e. Garden State Tile
 - f. Olympia Tile
 - g. Florida Tile Industries, Inc.
 - h. Summitville Tiles, Inc.
 - i. United States Ceramic Tile Company
2. Mortars and Grouts:
 - a. Bostik Construction Products Div. (Hydroment)
 - b. Custom Building Products
 - c. Laticrete International Inc.
 - d. Mapei Corp.
 - e. TEC Specialty Construction Brands Inc.
 3. Waterproofing Membranes: The Noble Co.
 4. Termination, Trim and Transition Strips: Schluter

2.2 PRODUCTS, GENERAL

- A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types, compositions, and grades of tile indicated.
 1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 1. Match color, texture, and pattern indicated by reference to manufacturer's standard designations for these characteristics.
 2. Provide tile trim and accessories that match color and finish of adjoining flat tile.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- E. Large Format Tiles: Large format tiles are defined to be tiles with any one single side larger than 15".

2.3 TILE PRODUCTS

- A. Porcelain Floor Tile CT-1:
 - 1. Module Size: 18" x 18"
 - 2. Thickness: 5/16 inch
 - 3. Finish: StepWise anti-slip treatment.
 - 4. Color: As scheduled
 - 5. Basis of Design Product: Daltile Astronomy or equal.

- B. Porcelain Floor Tile CT-2:
 - 1. Module Size: 12" x 24"
 - 2. Thickness: 3/8 inch
 - 3. Finish: StepWise anti-slip treatment.
 - 4. Color: As scheduled
 - 5. Basis of Design Product: Daltile Reminiscent or equal

- C. Porcelain Wall Tile CT-3:
 - 1. Module Size: 24" x 24"
 - 2. Thickness: 5/16"
 - 3. Finish: Matte
 - 4. Color: As scheduled
 - 5. Basis of Design Product: Daltile Florentine or equal.

2.4 STONE THRESHOLDS

- A. General: Provide stone that is uniform in color and finish, fabricated to sizes and profiles indicated or required to provide transition between tile surfaces and adjoining finished floor surfaces.
 - 1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2 inch (12.7 mm) or less, and finish bevel to match face of threshold.

- B. Marble Thresholds: Provide marble thresholds complying with ASTM C 503 requirements for exterior use and for abrasion resistance where exposed to foot traffic, a minimum hardness of 10 per ASTM C 241.
 - 1. Provide white marble thresholds.

2.5 WATERPROOFING/CRACK ISOLATION FOR TILE INSTALLATIONS

- A. General: Provide products that comply with ANSI A118.10 and the descriptions in this Article.

- B. Polyethylene-Sheet Waterproofing: Manufacturer's standard proprietary product consisting of composite sheets, 60 inches (1524 mm) wide by a nominal thickness of 0.030-inch (0.76 mm), composed of an inner layer of nonplasticized, chlorinated polyethylene sheet faced on both sides with laminated, high-strength, nonwoven polyester

material, designed for embedding in latex-portland cement mortar and as the substrate for latex-portland cement mortar setting bed. Provide at all locations for thin-setting.

1. Products: Provide Nobleseal TS manufactured by the Noble Company, or approved equal.
2. Location: Use at all thin set tile floors in bathrooms.

2.6 SETTING MATERIALS

- A. Medium-Bed, Latex-Portland Cement Mortar. Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of up to 3/4 inch. Provide one of the following, or approved equal:

1. MegaLite® Ultimate Crack Prevention Large Format Tile Mortar by Custom Building Products.
2. 4-XLT by Laticrete.
3. Large Tile and Stone Mortar by Mapei

- B. Latex-Portland Cement Mortar: Two component mortar system, comply with ANSI A118.4. Provide one of the following, or approved equal:

1. Laticrete 317 with Laticrete 333 additive; Laticrete International, Inc.
2. Kerabond with Keralastic; Mapei Corp.
3. Or equivalent.

2.7 GROUTING MATERIALS

- A. Water-Cleanable Epoxy Grout: ANSI A118.3. with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Grout shall be stain resistant, color fast, mold and mildew inhibiting, non-sag, suitable for joints 1/16" to 1/2" and sanded type suitable for installing with glazed tiles.

1. Basis of Design Product: Laticrete "Spectralock Pro Epoxy Grout" or equal.
2. Colors: As selected by Architect.

2.8 MISCELLANEOUS MATERIALS

- A. Metal Edge Strips: Zinc alloy or stainless steel terrazzo strips, 1/8-inch wide at top edge with integral provision for anchorage to mortar bed or substrate unless otherwise indicated.

- B. Notched Trowel: Use type recommended by tile manufacturer for setting large-format tiles, for setting bed thickness utilized.

- C. Termination, Trim and Transition Strips: Provide stainless steel Schluter units as scheduled below, or indicated on Drawings.

1. Cove Profile: Schluter "DILEX- AHK or equal.
2. Transition Strip: Schluter profile as indicated on Drawings.

3. Corner Guards: Refer to Division 10 Section "Wall and Door Protection."

- D. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by tile manufacturer for applications indicated.
- E. Grout Release: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
1. Mapei "UltraCare Grout Release".
 2. Miracle Sealants Co. "511 Impregnator"
- F. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- G. Grout Sealers: Water-based sealer for tile for protection from stains, as follows:
1. Mapei "UltraCare Grout Sealer".
 2. Miracle Sealants Co. "511 Impregnator"

2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
 3. Verify that subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.
 4. Perform moisture test at rate of one per 2,000 sq.ft.
 5. Verify that concrete substrates and cement board substrates are within the flatness tolerances required for setting large format tiles.

- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with manufacturer's installation specifications to prepare substrates indicated to receive tile.
- B. Use trowelable leveling and patching compounds per manufacturer's directions to fill cracks, holes, and depressions in substrates and to patch and level floors as required to provide suitable substrate for tile application.
- C. Remove coatings, including curing compounds, and other substances that could interfere with adhesion of tile by using a grinder, sander, or polishing machine with a heavy-duty wire brush.
- D. Broom or vacuum clean substrates to be covered by tiles immediately before tile installation. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- E. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- F. Transitions: Transitions of new to existing floor surfaces must be level. Use transition and edge pieces or slightly taper flash patching from one area to another as required to obtain level abutting surfaces.
- G. For large format tiles thin-set with medium bed mortar, provide the following surface preparation:
 - 1. Level substrates to 1/8-inch variance in 10 feet, with no more than 1/16 inch variation in 24 inches by one of the following methods:
 - a. Provide self-leveling hydraulic cement underlayment throughout project where new floor tile is installed.
 - b. Grind concrete floor substrates and patch with trowelable leveling and patching compound to achieve indicated flatness.
 - 1) Provide this method for bathroom floors
 - c. Skim coat and patch wall surfaces using manufacturer approved trowel-applied cement-based compound to bring surface into acceptable tolerances.
 - 2. There shall be no abrupt irregularities greater than 1/32".

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" that apply to type of setting and grouting materials and methods indicated.
 - B. TCNA Installation Guidelines: TCNA "Handbook for Ceramic Tile Installation"; comply with TCNA installation methods indicated.
 - C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
 - D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.
 - 1. Cut and grind tile edges where they abut curved surfaces to produce a close and uniform abutting joint.
 - E. Jointing Pattern: Lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work
 - F. Tile Patterns: Comply with pattern indicated on drawings.
 - G. Expansion Joints: Provide expansion joints, control joints and pressure relieving joints of widths and at locations as per TCNA Handbook Construction #EJ171. Do not saw cut joints after installation of tiles.
 - 1. Sealing of joints is included in Division 07 Section "Joint Sealers."
 - H. Apply grout release to tile surfaces prior to grouting. Prepare a small mock-up area of grout release application for Architect's approval before proceeding with application of grout release to installed tile surfaces.
 - I. Grout tile to comply with ANSI A108.10.
- 3.4 WATERPROOFING/CRACK SUPPRESSION MEMBRANE INSTALLATION
- A. Install waterproofing/crack suppression membrane to comply with manufacturer's written instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.

- B. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.5 FLOOR INSTALLATION METHODS

- A. Floor Tile: Install tile to comply with requirements indicated below for setting bed methods, TCNA installation methods related to types of subfloor construction, and grout types:

1. Concrete subfloor, TCNA F205, modified to comply with tile manufacturer's installation instructions, and as follows:
 - a. Bond Coat for Tile: Medium-Bed, Latex-Portland Cement Mortar, ANSI A108.5 over subfloor.
 - b. Grout: Epoxy grout.
 - c. Setting bed thickness shall be as required to produce finished floor surface at correct level for project.
 - d. Provide at non-wet floors (i.e. floors other than toilet rooms and janitor's closet).
2. Concrete subfloor with waterproofing/crack suppression membrane, TCNA F205 modified to comply with membrane manufacturer's installation instructions, details on drawings and as follows:
 - a. Bond Coat for Membrane: Medium-Bed, Latex-Portland Cement Mortar, ANSI A108.5 over subfloor.
 - b. Sheet membrane over bond coat, extend up walls 4 inches
 - c. Bond Coat for Tile: Medium-Bed, Latex-Portland Cement Mortar—ANSI A108.5 over membrane
 - d. Setting bed thickness shall be as required to produce finished floor surface at correct level for project.
 - e. Grout: Epoxy grout.
 - f. Provide at toilet room floors and janitor's closet.

- B. Joint Widths:

1. Porcelain Tile: 3/16" (overlap shall not exceed 33% when installing tile with a length 15" or greater in a staggered brick-joint pattern).

- C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

- D. Transition Strips (where gradual tapering of flash patch was not installed): Install at all edges where new tile meets existing flooring to ensure a smooth transition meeting ADA requirements.

- E. Stone Thresholds: Install stone thresholds at tile transitions at restrooms. Allow for bevel/chamfer as required. Set in same type of setting bed as abutting field tile unless otherwise indicated. Sealant is specified in Section 079200.

3.6 WALL INSTALLATION METHODS

- A. Wall Tile: Install tile to comply with requirements indicated below for setting-bed methods, TCNA installation methods related to subsurface wall conditions, and grout types:
 - 1. Cement Board - TCNA W244C, and as follows:
 - a. Bond Coat for Tile: Medium-Bed, Latex-Portland Cement Mortar, ANSI A108.5 over cement board.
 - b. Grout: Epoxy.
- B. Joint Widths: 1/8"(3/16" when installing tile with a length 15" or greater in a staggered brick-joint pattern; overlap should not exceed 33%.)

3.7 CLEANING AND PROTECTION

- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures that tile is without damage or deterioration at time of Substantial Completion.
 - 1. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 093100

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceilings consisting of
 - 1. Acoustical panels and exposed suspension systems.
- B. Related Sections include the following:
 - 1. Acoustical sealants are specified in Division 07 Section "Joint Sealants"

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product specified
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Ceiling suspension members.
 - 2. Method of attaching hangers to building structure.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 4. Minimum Drawing Scale: 1:100
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on samples of size indicated below.
 - 1. 6-inch- (150-mm-) square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch- (300-mm-) long samples of exposed suspension system members, including moldings and trim, for each color and system type required.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.
- B. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
- C. Maintenance Data: For finishes to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. **Installer Qualifications:** Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
 - B. **Source Limitations:** Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
 - C. **Fire-Test-Response Characteristics:** Provide acoustical panel ceilings that comply with the following requirements:
 - 1. **Surface-Burning Characteristics:** Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. **Flame Spread:** 25 or less.
 - b. **Smoke-Developed Index:** 450 or less
- 1.5 **DELIVERY, STORAGE, AND HANDLING**
- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
 - B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
 - C. Handle acoustical panels carefully to avoid chipping edges, soiling panels or damaging units in any way.
- 1.6 **PROJECT CONDITIONS**
- A. **Environmental Limitations:** Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- 1.7 **COORDINATION**
- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- 1.8 **EXTRA MATERIALS**
- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. **Acoustical Ceiling Components:** 2% of each type of panel installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide specified products by Armstrong World Industries or equivalent products.

2.2 ACOUSTICAL PANELS

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

- B. Acoustical Panels for Acoustical Panel Ceiling Type ACT-1: Where this designation is indicated, provide acoustical panels complying with the following:

1. Classification: Panels fitting ASTM E 1264 for Type XII, fiberglass with membrane-faced overlay; Form 2, water felted.
2. Pattern: Panels fitting ASTM E 1264 pattern designation (description) E (lightly textured).
3. Color: White.
4. Light Reflectance Coefficient: Not less than LR 0.90.
5. Noise Reduction Coefficient: 0.95
6. Ceiling Attenuation Class: N/A
7. AC: 190
8. Fire Rating: Class A
9. Sag Resistance Treatment: Armstrong HumiGuard Plus
10. Anti-Mold and Mildew Treatment: BioBlock
11. Warranty: 30 year
12. Edge Detail: Square tegular
13. Thickness: 1 inch.
14. Size: 24 by 24 inches.
15. Basis of Design Product: Armstrong Optima Square Tegular #3251, or equal.

- C. Acoustical Panels for Acoustical Panel Ceiling Type ACT-2: Where this designation is indicated, provide acoustical panels complying with the following:

1. Classification: Panels fitting ASTM E 1264 for Type XII, fiberglass with membrane-faced overlay; Form 2, water felted.
2. Pattern: Panels fitting ASTM E 1264 pattern designation (description) E (lightly textured).
3. Color: White.
4. Light Reflectance Coefficient: Not less than LR 0.90.
5. Noise Reduction Coefficient: 0.95
6. Ceiling Attenuation Class: N/A
7. AC: 190
8. Fire Rating: Class A
9. Sag Resistance Treatment: Armstrong HumiGuard Plus

10. Anti-Mold and Mildew Treatment: BioBlock
11. Warranty: 30 year
12. Edge Detail: Square tegular
13. Thickness: 1 inch.
14. Size: 24 by 48 inches.
15. Basis of Design Product: Armstrong Optima Square Tegular #3257, or equal.
16. Note: Cut this tile as required to fit existing construction when installing

2.3 METAL SUSPENSION SYSTEMS

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Suspension System for Acoustical Panel Ceiling Types ACT-1 and ACT-2: Narrow-Face, Bolt-Slot Tee, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G30 (Z120) coating designation, with prefinished 9/16-inch- wide metal bolt slot tee on flanges; other characteristics as follows:
 1. Face Design: Bolt slot with 1/8" reveal.
 2. Tee Material: Steel sheet.
 3. Tee Finish: Manufacturer's standard factory-applied painted finish in white.
 4. Basis of Design Product: Armstrong Silhouette XL or equal.
- C. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
 1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish and color as that used for exposed flanges of suspension system runners.

2.4 ACOUSTICAL SEALANT

- A. Refer to Division 07 Section "Joint Sealants".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for

- substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not attach hangers to steel deck tabs.
 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 7. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.
- 3.4 CLEANING
- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096500 - RESILIENT FLOORING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Luxury vinyl tile.
2. Vinyl wall base.
3. Resilient flooring accessories.

1.2 ACTION SUBMITTALS

A. Product data for each type of product specified.

1. Certification by adhesive manufacturer that products supplied for flooring installation comply with local regulations controlling use of volatile organic compounds (VOC's).

B. Samples for verification purposes in form of actual flooring or sections of accessories for each color and pattern specified

C. Shop Drawings: Indicate decorative pattern layout, if any. Indicate location of columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutout locations.

1.3 INFORMATIONAL SUBMITTALS

A. Maintenance data for resilient flooring and accessories.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility for Floor Tile and Accessories: Obtain each type, color, and pattern of tile and accessory from a single source; all stair accessories shall be from one manufacturer.

B. Fire Performance Characteristics: Provide resilient flooring with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648.
2. Smoke Density: Less than 450 per ASTM E 662.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient materials on flat surface in dry space protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).

- B. Move floor coverings and installation accessories into spaces where they will be installed at least 48 hours before installation, unless longer conditioning periods are recommended in writing by manufacturer.

1.6 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive resilient flooring for at least 72 hours prior to installation, during installation, and for not less than 72 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).
- B. Moisture Testing of Concrete Substrates: Perform moisture tests recommended by manufacturer and as follows. Do not install flooring if subfloor moisture emission rate exceeds indicated amounts.
 - 1. Calcium Chloride Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed the following maximum moisture-vapor-emission rate, unless otherwise allowed by adhesive manufacturer:
 - a. Luxury Vinyl Tile: Not more than 7 lb/1000 sq. ft./24 hours or 8 lb/1000 sq. ft./24 hours depending on adhesive used.
 - 2. Moisture Meter Testing: Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have relative humidity level measurement acceptable to flooring material manufacturer.
 - a. Luxury Vinyl Tile: 85 - 95% RH depending on adhesive used.
 - 3. Testing Procedures: Perform calcium chloride or moisture meter tests as required by floor topping and resilient tile manufacturers.
- C. Do not install flooring or accessories until they are at the same temperature as the space where they are to be installed.
- D. Close spaces to traffic during flooring installation.
- E. Flash patch 100% of the substrate under resilient flooring.

1.7 SEQUENCING AND SCHEDULING

- A. Install flooring and accessories after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

1. Luxury Vinyl Tiles:
 - a. Armstrong World Industries
 - b. Mannington Commercial
 - c. Tarkett
2. Base and Other Accessories:
 - a. Armstrong
 - b. Endura
 - c. Roppe
 - d. Johnsonite

2.2 PRODUCTS, GENERAL

- A. Colors, Textures, and Patterns: Provide tile and accessories in color, texture and pattern to match specified products. Colors and patterns indicated by reference to manufacturer's name and designations are for color and pattern identification only and are not intended to limit selection of other manufacturer's products with similar colors and patterns. If no colors or patterns are indicated, provide color(s) and pattern(s) as selected by Architect from manufacturer's standards.

2.3 RESILIENT TILE.

- A. Luxury Vinyl Tile (VT-1): Products complying with ASTM F 1700, Class III, Type B
1. Tile Size: 12" x 36"
 2. Total Thickness: 0.120"
 3. Wear Layer Thickness: 32 mil
 4. Surface Treatment: Techtonic
 5. Basis of Design Product: Meshwork by Tarkett.
 6. Color(s): As scheduled.
 7. Installation: As selected by Architect.
 8. Special Note: Owner will furnish approximately 1,300 SF of this tile which was prepurchased; provide remainder of tile required. Refer to notes on "Schedule of Finishes" on Drawings.

2.4 RESILIENT WALL BASE

- A. Vinyl Wall Base: ASTM F 1861, Type TV, Group 1 (solid), 4" high, 1/8" thick, smooth surface, and as follows:
1. Style: Cove base with toe (set-on type).
 2. Lengths: Coils in manufacturer's standard length.
 3. Inside and Outside Corners: Preformed
 4. Basis of Design Product: Traditional Wall Base by Johnsonite, a Tarkett Company..
 5. Color(s): As scheduled for each location.

2.5 MISCELLANEOUS RESILIENT ACCESSORIES

- A. Color: As selected by Architect from manufacturer's full range of colors produced for accessory molding complying with requirements indicated.
- B. Rubber Accessory Moldings: Provide rubber accessory molding complying with the following:
 - 1. Product Description: Carpet edge for glue-down applications, carpet nosing, nosing for rubber tile, reducer strip for resilient flooring, and tile and carpet joiner.
 - 2. Profile and Dimensions: As indicated or required.

2.6 INSTALLATION ACCESSORIES

- A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.
- B. Concrete Sealer: Type recommended and approved by resilient flooring manufacturer and adhesive manufacturer to ensure proper adhesion of resilient flooring to substrate.
- C. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- D. Adhesives (Cements): Products supplied by resilient flooring and accessory manufacturers, of type recommended to suit resilient products and substrate conditions indicated, and moisture levels of concrete substrate.
- E. Floor Polish: Acrylic type, as recommended by flooring material manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine areas where installation of flooring will occur, with Installer present, to verify that substrates and conditions are satisfactory for flooring installation and comply with flooring manufacturer's requirements and those specified in this Section.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond tests recommended by flooring manufacturer.
 - 2. Finishes of subfloors comply with tolerances and other requirements specified in Division 03 Section "Cast-In-Place Concrete" for slabs receiving resilient flooring.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.
- C. Concrete Moisture Emission Tests: Perform moisture meter tests and calcium chloride tests as per manufacturer's directions, as follows, and other tests if recommended by resilient flooring and adhesive manufacturer:
 1. Perform moisture test at rate of one per 2,000 sq.ft. of new and existing floor area to be covered.
 2. Report test results in writing to Architect, and Contractor within 24 hours after tests are completed. Reports of concrete moisture emission tests shall contain the Project identification name and number, date of test location of test within structure.
 3. Perform additional moisture emission tests of in-place concrete when test results indicate specified moisture content has been exceeded, as directed by Architect.
 - a. Repeat test one week after initial test minimally and additionally repeat test if required by field conditions to determine moisture levels in area of resilient flooring application.
- D. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with manufacturer's installation specifications to prepare substrates indicated to receive flooring.
- B. Use trowelable leveling and patching compounds per flooring manufacturer's directions to fill cracks, holes, and depressions in substrates and to patch and level floors as required to provide suitable substrate for flooring application.
 1. Flash patch 100% of the substrate under resilient flooring.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives by using a grinder, sander, or polishing machine with a heavy-duty wire brush.
- D. Broom or vacuum clean substrates to be covered by flooring immediately before installation of flooring. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.
- F. Seal concrete substrates as required by moisture test results to ensure proper adhesion of resilient flooring to substrate.

3.3 TILE INSTALLATION

- A. General: Comply with tile manufacturer's installation directions and other requirements indicated that are applicable to each type of tile installation included in Project.

- B. Lay out tiles from center marks established with principal walls so tiles at opposite edges of room are of equivalent width. Install tiles square with room axis, unless otherwise indicated.
- C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles in decorative pattern as indicated on drawings.
- D. Scribe, cut, and fit tiles to butt tightly to vertical surfaces and edgings.
- E. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- H. Adhere tiles to flooring substrates without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed tile installation.
- I. Use full spread of adhesive applied to substrate in compliance with tile manufacturer's directions including those for trowel notching, adhesive mixing, and adhesive open and working times.
- J. Hand roll tiles where required by tile manufacturer.

3.4 INSTALLATION OF WALL BASE AND ACCESSORIES

- A. General: Install resilient accessories according to manufacturer's written installation instructions.
- B. Apply resilient wall base to walls, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 1. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 2. Install preformed corners as per manufacturer's directions.

- C. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.

3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing installation:
 - 1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by resilient flooring manufacturer.
 - 4. Damp-mop flooring to remove black marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by flooring manufacturer.
 - 1. Apply protective floor polish to flooring surfaces that are free from soil, visible adhesive, and surface blemishes. Coordinate selection of floor polish with Owner's maintenance service requirements.
 - 2. Cover flooring with undyed, untreated building paper until inspection for Substantial Completion.
- C. Clean flooring not more than 4 days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean flooring using method recommended by manufacturer.
 - 1. Strip protective floor polish that was applied after completing installation prior to cleaning.
 - 2. Reapply floor polish after cleaning.

END OF SECTION 096500

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular carpet tile.
- B. Related Requirements:
 - 1. Division 09 Section "Resilient Flooring and Accessories" for resilient wall base and accessories installed with carpet tile.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.
 - 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. Maintenance Data: For carpet tile to include in maintenance manuals specified in Division 01. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- F. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for Gold, 52 to 70 points, based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Performance Characteristics of Carpet Tile: Provide carpet tile identical to that tested for the following performance characteristics, per test methods indicated:
 - 1. Flammability: Passes DOC FF 1-70 Pill Test.
 - 2. Flame Spread: Meets NFPA Class 1 when tested under ASTM E-648 Glue Down.
 - 3. Smoke Density: 450 or less, Flaming Mode when tested under NBS Smoke Chamber NFPA-258.
 - 4. Static: No more than 3.5 KV when tested under AATCC-134.
 - 5. Specific Optical Density: Not more than 300 in first 4 minutes tested in flaming or non-flaming mode when tested under ASTM E662.
 - 6. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648 or NFPA 253.
- C. Mockups: Before installing carpet tile, install mockups for each type of carpet tile installation required to demonstrate aesthetic effects and qualities of materials and execution. Install mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Install mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be installed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting work.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Remove mockups when directed.
 - 7. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion..

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI Carpet Installation Standard 2011.
- B. Store carpeting per manufacturer's recommendations for allowable temperature and humidity range. Products shall not be allowed to become damp.
- C. Remove carpeting from packaging and store in unoccupied, ventilated areas (100% outside air supply, minimum of 1.5 air changes per hour, no recirculation) for 24-72 hours prior to installation. Carpeting shall not be stored with materials which have high emissions of VOCs or other contaminants. Materials with high short-term emissions include, but are not limited to: adhesives, sealants and glazing compounds (specifically those with petrochemical vehicles or carriers); paint, wood preservatives, and finishes; control and/or expansion joint fillers; hard finishes requiring adhesive installation;

gypsum board (with associated finish processes and products); and composite or engineered wood products with formaldehyde binders

1.9 FIELD CONDITIONS

- A. Comply with CRI Carpet Installation Standard 2011 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.
- E. Flash patch 100% of the area to receive carpet tile.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: Lifetime.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Manufacturers: Provide specified products of Tarkett or equal manufactured by one of the following manufacturers:
 - 1. Interface
 - 2. Mannington
 - 3. Milikin
 - 4. Mohawk Commercial Carpet
 - 5. Shaw

- B. Sustainable Carpet Certification: Provide carpet tile that has a NSF/ANSI 140 rating of Gold or better.
- C. Emissions: Provide carpet tile that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
- D. Carpet Tile C-1:
 - 1. Construction: Stratatec patterned loop pile
 - 2. Fiber Content: Dynex SD Nylon
 - 3. Dye Method: Solution dyed
 - 4. Machine Gage: 5/64 in.
 - 5. Pile Thickness: 0.055 in
 - 6. Average Pile Height: 0.140 in.
 - 7. Stitches per Inch: 9.8
 - 8. Primary Backing: Synthetic non woven
 - 9. Secondary Backing: ethos Modular
 - 10. Size: 18 in x 36 in
 - 11. Guarantees: Lifetime limited.
 - 12. Basis of Design Product: Tarkett "Offset".
 - 13. Color(s): As scheduled
 - 14. Installation: As selected by Architect.
- E. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- F. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
- H. Carpet Edge Guard: Refer to Division 09 Section "Resilient Flooring and Accessories."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer. Do not install flooring if subfloor moisture emission rate exceeds indicated amounts.
 - a. Calcium Chloride Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed the maximum moisture-vapor-emission rate acceptable to flooring manufacturer.
 - b. Moisture Meter Testing: Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have relative humidity level measurement acceptable to flooring material manufacturer.
 - c. Testing Procedures
 - 1) Where flooring is indicated to be applied to structural concrete topping or concrete slab-on-grade substrates, perform moisture meter tests.
 - 2) Where flooring is indicated to be applied to areas where hydraulic cement topping is installed, perform calcium chloride or moisture meter tests as required by topping manufacturer.
 2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI Carpet Installation Standard 2011, Section 7, "Site Conditions; All Installations," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
1. Flash patch 100% of the substrate to receive carpet tile.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI Carpet Installation Standard 2011, Section 18, "Modular Carpet," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders, unless otherwise indicated.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI Carpet Installation Standard 2011, Section 20, "Protecting Indoor Installations."
 - 1. Restrict traffic over adhesive installations for a minimum of 48 hours to allow proper adhesive cure.
 - 2. Restrict exposure to water from cleaning or other sources for a minimum of 30 days.
 - 3. If required to protect the finished floor covering from dirt or paint, or if additional work is to be done after the installation, cover carpeting with a non-staining building material paper.
 - 4. Protect the installation from rolling traffic by using sheets of hardboard or plywood in affected areas.

- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior and exterior substrates:
 - 1. Steel and iron.
 - 2. Galvanized metal.
 - 3. Gypsum board.
- B. Related Sections include the following:
 - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

- A. MPI Standards: Maintain copy of this standard at the Project site at all times.
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.5 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
 2. PPG Architectural Finishes, Inc.
 3. Sherwin-Williams Company (The).

4. Tnemec

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the OTC (Ozone Transport Commission) restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Shellacs, Clear: VOC not more than 730 g/L.
6. Shellacs, Pigmented: VOC not more than 550 g/L.
7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
10. Floor Coatings: VOC not more than 100 g/L.
11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
14. Dry-Fog Coatings: VOC content of not more than 400 g/L.
15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
16. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
17. Fire Retardant Paint: VOC content of not more than 60 g/L.

C. Colors: As scheduled or if not scheduled, as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- F. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Application Procedures: Apply paints and coatings by brush or roller according to the manufacturer's directions, except s noted below. Spray application is not permitted for trim, ceilings and walls, unless specifically approved by Architect in advance for each individual situation. Roller application on woodwork is not permitted.
1. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 2. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 3. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
- C. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- D. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- E. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- F. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- G. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. General: Provide listed products or equal products of other named manufacturers in Part 2.
- B. Steel and Iron Substrates: Polyurethane, Pigmented, Epoxy Zinc Rich Primer and High-Build Epoxy Coating System: Gloss or Semi-Gloss as selected by the Architect.
 1. Prime Coat: Epoxy Zinc Rich Primer. Tnemec: Tneme-Zinc Series 90-97 or equal.

2. Intermediate Coat: High-performance, polyamide-epoxy coating; High-Build Epoxy Marine Coating, Low Gloss: Tnemec: Hi-Build Epoxoline, Series 66, tinted slightly lighter than top coat., or equal
 3. Topcoat (Gloss): Aliphatic Acrylic Polyurethane, Two-Component, Pigmented, Gloss: Tnemec Endura-Shield II Series 1074.
 4. Topcoat (Semi-Gloss): Aliphatic Acrylic Polyurethane, Two-Component, Pigmented, Semi-Gloss: Tnemec Endura-Shield II Series 1075.
- C. Zinc-Coated (Galvanized) Metal: Full-gloss, acrylic latex enamel finish - 2 coats - self-priming.
1. Prime Coat: Gloss acrylic latex enamel paint; MPI # 114, X-Green 114, 154, X-Green 154, 164, LEED 2009, LEED V4.
 - a. Benjamin Moore Ultra Spec D.T.M. Acrylic Gloss Enamel HP28
 2. Top Coat: Gloss acrylic latex enamel paint; MPI # 114, X-Green 114, 154, X-Green 154, 164, LEED 2009, LEED V4.
 - a. Benjamin Moore Ultra Spec D.T.M. Acrylic Gloss Enamel HP28
- ### 3.7 INTERIOR PAINTING SCHEDULE
- A. General: Provide listed products or equal products of other named manufacturers in Part 2.
- B. Gypsum Board Ceilings: Flat acrylic finish.
1. Prime Coat: Latex-based, interior primer; MPI # 50, X-Green 50, 149, X-Green 149, LEED 2009, LEED V4, CHPS Certified.
 - a. Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534
 2. Intermediate Coat and Topcoat: Factory-formulated flat acrylic latex paint for interior application; MPI # 53, X-Green 53, 143, X-Green 143, LEED 2009, LEED V4, CHPS Certified.
 - a. Benjamin Moore; Ultra Spec 500 Interior Latex Flat N536
- C. Gypsum Drywall Walls: Low-luster (eggshell), acrylic finish.
1. Prime Coat: Latex-based, interior primer; MPI # 50, X-Green 50, 149, X-Green 149, LEED 2009, LEED V4, CHPS Certified.
 - a. Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534
 2. Intermediate Coat and Topcoat: Low-luster (eggshell or satin), acrylic-latex, interior enamel; MPI # 52, X-Green 52, 145, X-Green 145, 139, X-Green 139, LEED 2009 LEED V4, CHPS Certified.
 - a. Benjamin Moore; Ultra Spec 500 Latex Eggshell N538.
- D. Gypsum Drywall Walls at Bathrooms and Janitor's Closets: Semi-Gloss, waterborne acrylic epoxy finish.

1. Prime Coat: Latex or two component epoxy-based, interior primer; MPI # 6, 17, X-Green 17, 39, 137, X-Green 137, LEED Credit, CHPS Certified.
 - a. Benjamin Moore; Fresh Start Multi-Purpose Primer N023.

 2. Intermediate Coat and Topcoat: Two component semi-gloss acrylic-epoxy; Interior/Exterior Epoxy (water based), LEED 2009.
 - a. Benjamin Moore; Corotech Pre-Catalyzed Waterborne Epoxy Semi-Gloss V341.
- E. Hollow Metal Doors, Frames, and Sidelights, and Ferrous Metals: Semigloss, acrylic-enamel finish.
1. Prime Coat: Rust-Inhibitive Primer (Water Based), MPI #107, X-Green 107, 134, LEED 2009, CHPS Certified.
 - a. Benjamin Moore; Super Spec HP Acrylic Metal Primer P04.

 2. Intermediate Coat and Topcoat: Factory-formulated semigloss acrylic-latex enamel for interior application; MPI # 141, X-Green 141, 153, X-Green 153, LEED 2009, LEED V4.
 - a. Benjamin Moore; Ultra Spec HP D.T.M. Acrylic Semi-Gloss Enamel, HP29

END OF SECTION 099100

SECTION 101200 - DISPLAY CASES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonilluminated bulletin boards.

1.2 DEFINITIONS

- ##### **A. Bulletin Board:** Tackable visual display surface or tackboard enclosed in a display case.

1.3 SUBMITTALS

- ##### **A. Product Data:** For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for display cases.
- ##### **B. Shop Drawings:** For display cases. Include plans, elevations, sections, details, and attachments to other work

1.4 CLOSEOUT SUBMITTALS

- ##### **A. Maintenance Data:** For visual display surfaces, operating hardware to include in maintenance manuals.
- ##### **B. Keys for locking doors.**

1.5 QUALITY ASSURANCE

- ##### **A. Source Limitations:** Obtain display cases from single source from single manufacturer.

1.6 PROJECT CONDITIONS

- ##### **A. Environmental Limitations:** Do not deliver or install display cases until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. **Low-Emitting Materials:** All composite wood, engineered wood, or agrifiber products (e.g., plywood, particleboard, medium density fiberboard) shall contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins. Acceptable resins and binders include, but are not limited to, phenol formaldehyde and methyl diisocyanate (MDI)
- B. **VOC Limits for Installation Adhesives and Glues:** Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Contact Adhesive: 80 g/L

2.2 MATERIALS

- A. **Hardboard:** ANSI A135.4, tempered.
- B. **Particleboard:** ANSI A208.1, Grade 1, no added urea-formaldehyde resins.
- C. **Hardwood Plywood:** HPVA HP-1, no added urea-formaldehyde resins .
- D. **Natural Cork Sheet:** Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish.
- E. **Extruded-Aluminum Bars and Shapes:** ASTM B 221 (ASTM B 221M), Alloy 6063.
- F. **Clear Tempered Glass:** ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering, and 3/16 inch thick unless otherwise indicated.
- G. **Fasteners:** Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.
- H. **Adhesives:** Manufacturer's standard product.

2.3 BULLETIN BOARD

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. **Nonilluminated Bulletin Boards:**
 - a. AARCO Products, Inc.
 - b. Best-Rite Manufacturing.

- c. Claridge Products and Equipment, Inc.
 - d. Ghent Manufacturing, Inc.

 - B. **General:** Factory-fabricated unit consisting of manufacturer's standard wall-mounted cabinet with tackboard assembly on back inside surface and operable glazed doors at front.

 - C. **Basis of Design Product:** Enclosed Bulletin Board with Aluminum Frame and Sliding glass Doors Model No. SBC4872 by AARCO Products Inc. or equal.

 - D. **Metal Framed Cabinet:** Fabricate frames and trim of not less than 0.062-inch-thick, extruded-aluminum alloy, 1" x 3" rectangular perimeter trim. Provide straight, single-length units. Keep joints to a minimum. Miter corners to a neat, hairline closure. Provide in clear satin anodized finish.

 - E. **Cabinet Corners:** Square, mitered.

 - F. **Glazed Sliding Doors:** Tempered glass; frameless sliding doors. Provide sliding glass door shoe, channel and track. Equip each door with ground finger pull and an adjustable cylinder showcase type lock with two keys located at bottom of doors.
 - 1. Thickness: 1/4 inch.
 - 2. Number of Doors: Two.

 - G. **Natural Cork Tackboards:** Seamless sheet, 1/4-inch-thick, ground natural cork compressed with a resinous binder, laminated to burlap backing and 1/4" tempered hardboard.

 - H. **Size:** 48 by 72 inches.

 - I. **Depth:** 3 inches overall.

 - J. **Mounting:** Surface mounted utilizing Z-bar hangers..
- 2.4 **FABRICATION**
- A. Fabricate bulletin boards to requirements indicated for dimensions, design, and thickness and finish of materials.

 - B. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper backing for bulletin boards.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
 - 1. Mounting Height: As indicated on Drawings.
- B. Bulletin Boards: Attach units to wall surfaces with manufacturer's standard concealed hardware.

3.3 ADJUSTING AND CLEANING

- A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

END OF SECTION 101200

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Panel signs.
2. Signage accessories.

1.2 ACTION SUBMITTALS

A. **Product Data:** Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. **Shop Drawings:** Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.

1. Provide message list for each sign, including large-scale details of wording, lettering, and braille layout.

C. **Samples for Initial Selection:** For each type of sign material indicated that involves color selection.

1. **Panel Signs:** Samples of each finish type and color, on not less than 4-inch squares of plastic material, showing the full range of colors available

D. **Samples for Verification:** For each type of sign, include the following Samples to verify color selected:

1. **Panel Signs:** Full-size Samples of each type of sign required.
2. Approved samples will be returned for installation into Project.

1.3 INFORMATIONAL SUBMITTALS

A. **Qualification Data:** For Installer.

B. **Maintenance Data:** For signage cleaning and maintenance requirements to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. **Installer Qualifications:** An employer of workers trained and approved by signage manufacturer.

- B. Source Limitations: Obtain each sign type through one source from a single manufacturer.
- C. Regulatory Requirements: Comply with ANSI A.117.1 - 2017 and with code provisions as adopted by authorities having jurisdiction.
 - 1. Interior Code Signage: Provide signage as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to, the following:
 - a. Room Capacity.
 - b. Elevator Signs.
 - c. Stairway Identification.
 - d. Signs for Accessible Spaces.

1.5 COORDINATION

- A. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices and advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

PART 2 - PRODUCTS

2.1 PANEL SIGNS

- A. General: Provide signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
 - 1. Produce smooth, even, level sign surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.58 mm) measured diagonally.
 - 2. Sign materials shall meet a Class A finish.
- B. Panel Signs: Provide lettering, graphics and background materials in styles and colors to match those specified on Drawings.
 - 1. Material: 0.040 matte clear brushed aluminum face plates. Clear anodized aluminum base plates and side rails.
 - 2. Provide sign design and layout as indicated on Drawings.
 - 3. Lettering and Braille Content: Provide letters raised 1/32 inch, and grade 2 braille for each specific location. Minimum text height: 5/8 inch.
 - 4. Pictograms: Provide graphics raised 1/32 inch, with lettering and braille written description directly below.
 - 5. Lettering Style: As indicated on Drawings.
 - 6. Copy Location: As indicated on Drawings.
 - 7. Corners and Edges: As indicated on Drawings.
 - 8. Basis of Design Product: Nexus ADA Room Signs by Signworks to match existing signage in the building

- C. Provide specified signage as scheduled on Drawings

2.2 PANEL SIGN ACCESSORIES

A. Mounting Methods:

1. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides; 3M "VHB Heavy Duty Mounting Tape" or equal.
2. Adhesive: As recommended by sign manufacturer.
3. Mechanical Fasteners: Stainless steel screws.

- B. Provide back plates where signs are mounted to glass.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items, including anchor inserts, provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Locate interior wall signs and accessories where indicated, in accordance with ANSI A.117.1 - 2017 and with code provisions as adopted by authorities having jurisdiction, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
 2. Mount signs on wall adjacent to the latch side of door, unless otherwise indicated. Where there is no wall space to the latch side of the door, including at double leaf doors, mount sign on the nearest adjacent wall as approved by the Architect. Mount signs at 48-inches (1219 mm) from the baseline of the lowest characters to the finished floor.
 3. Locate signs to allow approach within 3-inches (75 mm) of sign without encountering protruding objects or standing within swing of door.

- B. **Wall-Mounted Panel Signs:** Attach signs to wall surfaces using concealed methods indicated below:
1. **Mechanical Fasteners:** Use nonremovable mechanical fasteners placed through predrilled holes in frames. All mechanical fasteners shall be concealed. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
 2. **Adhesive:** Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 3. **Double Sided Tape:** Apply to back of sign, peel off protective covering and press firmly to wall in desired location.
- C. **Glass-Mounted Panel Signs:** Provide backer panel that matches color and size of panel sign and adhere to glass surface using double-faced tape. Mount panel signs to backer panel using self-adhesive methods.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

3.4 INTERIOR SIGN SCHEDULE

- A. Provide signage as scheduled on the Drawings.

END OF SECTION 101400

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid-plastic polymer resin units as follows:

1. Toilet Enclosures: Floor-anchored, overhead braced.
2. Urinal Screens: Wall hung

B. Toilet accessories are specified in another Division 10 Section.

1.2 ACTION SUBMITTALS

A. Product data for each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.

B. Shop drawings for fabrication and erection of toilet compartment assemblies not fully described by product drawings, templates, and instructions for installation of anchorage devices built into other work.

1. Show locations of reinforcement and cutouts for compartment-mounted toilet accessories.

C. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch- (150-mm-) square samples of same thickness and material indicated for Work

1.3 QUALITY ASSURANCE

A. Coordination: Furnish inserts and anchorages which must be built into other work for installation of toilet compartments and related items. Coordinate delivery with other work to avoid delay.

B. Fire-Test-Response Characteristics: Provide toilet compartment materials with surface-burning characteristics as indicated below, as determined by testing identical to those required in this Section, per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify toilet compartments with appropriate markings of applicable testing and inspecting agency.

1. Flame Spread: 200 or less.
2. Smoke Developed: Less than 450, or Smoke Density: less than 75 per ASTM D 2843

C. Flammability of Self-Supporting Plastics: 1.2 inches (30.5-mm) per minute or less per ASTM D 635.

D. Ignition Properties of Plastic: Not less than 650 Deg. F (343.3 Deg. C) per ASTM D 1929.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.5 WARRANTY

- A. Warranty shall not deprive the Owner of other rights or remedies that the Owner may have under other provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- B. Provide a manufacturer's warranty covering the material and workmanship for a period of ten years from the date of final acceptance.
- C. Repair or replace any part which becomes defective or breaks during the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Bradley
 - 2. General Partitions Mfg. Corp.
 - 3. Global Partitions
 - 4. Metpar Corp.
 - 5. Scranton Products (Santana/Comtec/Capital)

2.2 MATERIALS

- A. General: Provide materials which have been selected for surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.
- B. Solid-Plastic, Polymer Resin: High-density polyethylene (HDPE) with homogenous color throughout. Provide material not less than 1 inch (25 mm) thick with seamless construction and eased edges in color and pattern as follows:
 - 1. Texture: Hammered.
 - 2. Color: Stainless
 - 3. Door and Panel Edges: Shiplap
 - 4. Partition Type: High Privacy

- a. Height: 62 inches (1575 mm) high and mounted at 8 to 14 inches (203 to 356 mm) above the finished floor.
 - b. Doors: 60 degree angle on two opposite edges for enhanced privacy.
 - c. Dividing Panels: Two modular pieces, both slotted on one edge to accept wall bracket
5. Basis of Design Product: Eclipse Partitions manufactured by Scranton Products, or equal.
- C. Metal Posts: 82.75 inches (2102 mm) high, heavy duty extruded aluminum, clear anodized finish, fastened to foot with stainless steel tamper resistant screw.
- D. Hidden Shoe (Foot): One-piece molded polyethylene invisible shoe inserted into metal post and secured to metal post with stainless steel tamper resistant screw.
- E. Headrail Cap and Corner Cap: One-piece molded polyethylene secured to metal post with stainless steel tamper resistant screw; adjustable to level headrail to finished floor.
- F. Hidden Wall Brackets: Continuous heavy duty extruded aluminum, clear anodized finish, inserted into slotted panel and fastened to panels with stainless steel tamper resistant screws.
1. Type: Single ear bracket aluminum.
 2. Type: Double ear bracket aluminum.
 3. Length: 65 inches (1651 mm).
- G. Headrail: Heavy duty extruded aluminum, designer anti-grip design, clear anodized finish, fastened to headrail bracket with stainless steel tamper resistant screw and to headrail cap or corner cap with stainless steel tamper resistant screw.
1. Headrail Brackets: Heavy duty extruded aluminum, clear anodized finish, secured to wall with stainless steel tamper screws.
- H. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories as listed below. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be handicapped accessible.
1. Hinges: Edge-mounted stainless steel continuous hinge.
 2. Door Keeper: Fabricated from heavy duty extruded aluminum, clear anodized finish.
 - a. Length: 3-1/2 inches (89 mm).
 - b. Mount in gap between dividing panel and door.
 3. Latch and Housing: Fabricated from heavy duty extruded aluminum.
 - a. Latch housing: Clear anodized finish.
 - b. Slide bolt and button: Black anodized finish.
 - c. Provide occupancy indicator.
 4. Door Pulls: Fabricated from heavy duty extruded aluminum, clear anodized finish.

- a. Single component providing door pull capability on outswing doors.

5. Door Stop: Coat hook bumper.

- I. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

- A. General: Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, as indicated.
- B. Overhead-Braced Compartments: Provide anodized aluminum angle supports and leveling bolts at pilasters as recommended by manufacturer to suit floor conditions. Make provisions for setting and securing continuous, extruded, aluminum, antigrip, overhead bracing at top of each pilaster. Provide shoe at each pilaster to conceal supports and leveling mechanism.
- C. Screens: Attach with anchoring devices as recommended by manufacturer to suit supporting structure. Set units to provide support and to resist lateral impact.
- D. Doors: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be handicapped accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Provide clearances of not more than 1/2 inch (13 mm) between pilasters and panels and not more than 1 inch (25 mm) between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.
 1. Secure panels to walls and panels with continuous brackets attached to the panel. Locate wall bracket fasteners so holes for wall anchors occur in masonry or tile joints. Secure panels in position with manufacturer's recommended anchoring devices.
- B. Overhead-Braced Compartments: Secure pilasters to floor and level, plumb, and tighten installation with devices furnished. Secure overhead brace to each pilaster with not less than two fasteners. Hang doors and adjust so that tops of doors are parallel with overhead brace when doors are in closed position.

- C. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUST AND CLEAN

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.
- B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 102113

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Corner guards.
2. Crash rails.

1.2 SUBMITTALS

- A. **Product Data:** Include physical characteristics for each wall and door protection system component indicated.
- B. **Shop Drawings:** Show locations, extent, and installation details of each wall and door protection system component. Show methods of attachment to adjoining construction.

1.3 QUALITY ASSURANCE

- A. **Source Limitations:** Obtain each type of wall and door protection units through one source from a single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.5 PROJECT CONDITIONS

- A. **Environmental Limitations:** Do not install wall and door protection components until the space is enclosed and weatherproof and ambient temperature within the building is maintained at not less than 70 deg F (21 deg C) for not less than 72 hours before beginning installation.
- B. **Field Measurements:** Where units are indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.

PART 2 - PRODUCTS

2.1 CORNER GUARDS

- A. Metal Corner Guards: Finishing and edge-protection profile for the outside corners of tiled or panel surfaces, with a trapezoid-perforated anchoring leg that is secured to the substrate and a reveal that forms a square outer corner along the surface edge. Provide inside and outside corners as required for complete installation.
 - 1. Material for Bathrooms: Stainless steel, Type 304, with brushed finish.
 - 2. Material for Corridors: Aluminum, in finish to match aluminum baseboards.
 - 3. Size: As required for each installation condition.
 - 4. Basis of Design Product: QUADec by Schluter, or equal.

2.2 CRASH RAIL

- A. Surface-Mounted, Crash Rail: Surface mounted assembly consisting of a continuous extruded aluminum retainer with snap on Acrovyn 4000 cover and integral shock absorbing cushion. Provide color matched end caps and corners and attachment hardware appropriate for wall construction.
 - 1. Extruded cover material shall be high impact Acrovyn 4000 with shadowgrain texture, nominal .078" thickness.
 - 2. Aluminum Retainer: Nominal .085" thick aluminum extrusions, 1-1/2" with continuous regrind PETG bumper cushion.
 - 3. Dimensions: 8" high with 1-1/4" wall offset, in maximum lengths available.
 - 4. Basis of Design Product: Model SCR-64N by Construction Specialties, Inc., or equal.
 - 5. Color: As selected by Architect.
 - 6. Class A fire rating.

2.3 FABRICATION

- A. General: Fabricate wall and door protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thicknesses of components.
- B. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.4 METAL FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions in which wall and door protection system components and materials will be installed.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection system components.
- B. General: Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. General: Install wall and door protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 - 1. Install wall and door protection units in locations and at mounting heights indicated on Drawings.
- B. Do not use materials that are unsound, warped, bowed or twisted.
- C. Crash Rails: Install in conformance with manufacturer's directions using only approved hardware. Adjust installed end caps as necessary to ensure tight seams. Where splices occur in horizontal runs, splice retainer and rail at different locations along the run. Locate all components firmly into position, level and plumb.

END OF SECTION 102600

SECTION 102800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Washroom accessories.
2. Metal framed mirrors.
3. Custodial accessories.
4. Warm air hand dryers.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Contract Drawings.
2. Identify products using designations indicated on Contract Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals, including replaceable parts and service recommendations.

1.3 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

B. Inserts and Anchorages: Furnish accessory manufacturer's standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.5 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Fifteen (15) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-Of-Design Products: The design for toilet accessories is based on Bobrick Washroom Equipment, unless otherwise indicated. Subject to compliance with requirements, provide the named product or an equivalent product by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bradley Corporation.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch (0.8-mm) (22-gage) minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) (20-gage) minimum nominal thickness.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- D. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick, Class 1, Quality q2, and with silvering, electro-plated copper coating, and protective organic coating.

H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.3 WASHROOM ACCESSORIES

A. Washroom Accessories: Provide Basis of Design Products scheduled on Drawings, or equal.

2.4 CUSTODIAL ACCESSORIES

A. Surface-Mounted Utility Shelf with Mop and Broom Holder: Fabricate shelf, mop holder and hook support of 18-gage type 304 stainless steel with satin finish, welded construction. Provide unit with stainless steel rag hooks, rod for wet rags below shelf, and spring loaded rubber cam mop and broom holders with no slip coating. 8-inch (203.2 mm) deep and 6-inch (152.4 mm) high with three (3) hooks and four (4) mop holders.

1. Product: Bobrick B-224, in 36-inch (915 mm) length, or equal.

2.5 FABRICATION

A. General: No names or labels are permitted on exposed faces of toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification of each accessory item either by a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product number

B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

C. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors or access panels with full-length, stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

D. Mirror Unit Hangers: Provide system for mounting mirror units that will permit rigid, tamperproof, and theftproof installation.

E. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six (6) keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's written instructions for type of substrate involved.
- C. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446, and in compliance with ADA Regulations.

3.2 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for unencumbered, smooth operation. Verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations after removing temporary labels and protective coatings.

END OF SECTION 102800

SECTION 124813 - FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Recess-mounted linked-tread-type floor mats and frames.

1.2 ACTION SUBMITTALS

- A. Product data for each type of floor mat and frame specified, including manufacturer's specifications and installation instructions, details of construction relative to materials, dimensions of individual components, profiles, and finishes..
- B. Shop drawings showing layout and types of floor mat, full-scale sections of typical installations, details of patterns or designs, anchors, and accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Maintenance data in the form of manufacturer's printed instructions for cleaning and maintaining floor mats.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain each type of floor mats from one source of a single manufacturer.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Check actual locations for mats installation by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid a delay of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Construction Specialties, Inc.
 2. Mats Inc.
 3. Reese Enterprises, Inc.

4. Pawling Corp.

2.2 MATS

- A. Aluminum Linked-Tread Floor Mats: Extruded 6105-T5 aluminum alloy with 3/4" deep serrated aluminum tread rails joined by a flexible TPE combination hinge and cushion to compromise the overall grid length (traffic direction). The hinge shall be complete with perforations between each tread rail for drainage.

1. Aluminum Finish: Clear anodized.
2. Tread Spacing: 1-1/2" o.c.
3. Wheel Load: 1000 lbs (load applied to a 5" x 2" wide polyurethane wheel, 1000 passes without damage).
4. Basis of Design Product: "PediTread G7 (SA)" by Construction Specialties, Inc., or equal

- B. Mat Frame: 1" deep recessed frame in 6063-T6 aluminum alloy with a 1/4" wide exposed surface. Black TPE filler trims shall be furnished as required, when standard 1-1/2" tread spacing cannot be maintained. Installer shall use recommended latex screed to ensure level base. Frame finish to be clear anodized

1. Basis of Design Product: "LB Level Base Frame" by Construction Specialties, Inc., or equal.

2.3 MISCELLANEOUS MATERIALS

- A. Provide latex leveling screed material of type recommended by mat manufacturer.

2.4 FABRICATION

- A. Shop-fabricate units of floor mat work to greatest extent possible in sizes as indicated. Where not indicated otherwise, provide single unit for each mat installation, but do not exceed manufacturer's maximum size recommendation for units intended for removal and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes and note locations on shop drawings. Verify sizes by field measurement before shop fabrication.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for location, size, and minimum depth affecting installation of foot mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 INSTALLATION

- A. Prepare substrate by applying latex leveling screed to ensure level base.
- B. Install recess-mounted frames and mats to comply with manufacturer's instructions at locations indicated and with top of frames and mats in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set mat tops at height for most effective cleaning action and coordinate top of mat surfaces with doors that swing across mats to provide clearance under door.

3.3 PROTECTION

- A. Defer installation of floor mats until time of Substantial Completion for Project.

END OF SECTION 124813

SECTION 142150 – ELEVATOR MODERNIZATION**PART 1 - GENERAL****1.1 SUMMARY****A. This Section includes the following:**

1. Elevator Modernization
2. Card Reader Security System Details and Scope of Work – Appendix II

Note: Drawings are provided separately. In the event of any real or apparent conflict in the scope of work, the more stringent conditions shall apply.

1.2 SCHEDULE OF ELEVATOR(S)**Two (2) Passenger Elevators**

See detailed information provided on Appendix I

1.3 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes and similar information.
- B. Shop Drawings: Show plans, elevations, sections and large scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Indicate loads imposed on building structure at points of support, and maximum and average power demands.
No general submissions will be made. Details if equipment that is directly proposed for the job shall be submitted. All submissions will be made in binders that must be appropriately formatted.

List of Submittals

- MAIN LINE DISCONNECT
- MACHINE – BRAKE, SHEAVES, WIRE ROPES
- HOIST MOTOR
- CONTROLLER SELECTOR & DISPATCHER -
- OPERATION, CONTROL, AND SIGNAL SYSTEMS.
- MOTOR CONTROL & DRIVE UNIT
- GOVERNOR & TENSION SHEAVE
- COUNTERWEIGHT ASSEMBLY
- PLATFORM, SLING & SAFETY
- ELEVATOR CAR ENCLOSURES & HOISTWAY ENTRANCES.
- DETECTOR EDGE
- “Z” BRACKET

- DOOR OPERATOR, TOP OF CAR INSPECTION STATION, CAB DOOR AND HOISTWAY EQUIPMENT
- LIGHTING FIXTURES
- LIMITS & LIMIT SWITCHES
- SILLS AND SADDLES
- EMERGENCY BRAKE
- ROLLER GUIDES / SHOES
- EMERGENCY POWER UNIT & ALARM BELL
- BUFFERS
- OTHER MAJOR EQUIPMENT NOT LISTED

List of Initial Project Submittals as applicable (at least three (3) sets):

- A separate page listing the manufacturers of proposed equipment for approval with the bid package.
- This list will also include names of all subcontractors, organizations or individuals not directly employed by the contractor that will be involved with the project. Provide description of proposed work.
- Shop drawings:
 - Show equipment arrangement in the machine room, corridor, pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
 - Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
 - Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
 - Indicate electrical power requirements & branch circuit protection device recommendations.
 - Layout drawings indicating the location of all equipment, switches, limits and electrical sources
- Information Required on Layout Drawings
Elevator layout drawings shall, in addition to other data, indicate the following:
 - (a) the maximum bracket spacing
 - (b) the estimated maximum vertical forces on the guide rails on application of the safety .
 - (c) in the case of freight elevators for Class B or C loading , the horizontal forces on the guiderail faces during loading and unloading, and the estimated maximum horizontal forces in a post-wise direction on the guide-rail faces on the application of the safety device
 - (d) the size and linear weight kg/m (lb/ft) of any rail reinforcement, where provided
 - (e) the total static and impact loads imposed on machinery and sheave beams, supports, and floors or foundations
 - (f) the impact load on buffer supports due to buffer engagement at the maximum permissible speed and load.
 - (g) where compensation tie-down is applied , the load on the compensation tie-down supports
 - (h) the total static and dynamic loads from the governor, ropes, and tension system
 - (i) the horizontal forces on the building
- Cab and Counterweight load calculations including differential weights and details of what work needs to be performed to achieve code mandated counterbalance and changes to building reactions.
- Power requirements for the elevator(s) and individual major equipment. Heat outputs of machine room equipment to size HVAC equipment.
- Cab and Hallway fixture details, including color swatches and finish samples. Samples must at a minimum, include buttons, tags, jamb markers, cab material, entrance and signal fixture and edging.
- Wiring diagrams & equipment cut sheets.
- A detailed schedule to be submitted which must include the following:
- Equipment lead times after approval.

- Detailed breakdown of tasks
- Any County items (fire extinguisher, power, main line, communications line, lighting, etc)
- Cab drawings and details of walls ceiling & flooring. Provide finished cab weight & weight differential.
- Hoistway entrance details.
- Technical details of drives, controls, selector, dispatcher and sequence of operation.
- Prior to commencement, elevator & electrical permits filed with the Department of buildings.

C. Samples: For Exposed finishes

D. Manufacturer Certificates: Signed by Elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

E. Operation and Maintenance data.

F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with ASME A17.1 (latest applicable version) and elevator design requirements for earthquake loads in ASCE 7

B. APPLICABLE CODES, STANDARDS, AND PUBLICATIONS

- New York State Building Code
- White Plains Building Code
- Latest version of ASME A17.1 with all amendments.
- National Electronic Code NFPA 70.
- Life Safety Code, NFPA 101.
- Specifications and references in this Section do not supplant any code requirements governing the design, fabrication, installation or operation of the equipment.
In case of any conflict in applicable codes, regulations or standards, the most stringent requirement shall take precedent.
- The elevator supplier shall be licensed and governed by local and governmental authorities.
- ASME -American Society of Mechanical Engineers / ANSI -American National Standards Institute
 - ANSI A117
 - White Plains Vertical Transportation Code.
- New York State Building Code
- White Plains Building Code
- Uniform Building Code and Local Building Codes – Applicable versions in effect at the time of filing.
- The NY State Electrical Code & National Electric Code (NEC) by reference
- Industry Standard Publications by George Strakosch, where applicable.
- National Fire Protection Association (NFPA).
- The National Electrical Code
- Fire Safety of Hoistway Entrances.
- Life Safety Code
- OSHA – Occupational Safety and Hazard Administration

- Americans with Disabilities Act (ADA) Application Guidelines
 - Environmental Protection Agency (EPA)
 - Building Officials and Code Administrators - Building Code
 - IEEE - Institute of Electrical and Electronics Engineers, Inc.
 - Other Codes as applicable
- C. **Manufacturer Qualifications:** A manufacturer regularly engaged in manufacturing, installing, and servicing elevators of the type required for the project. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment. The major parts of the elevator equipment shall be manufactured by the manufacturing company, and not be an assembled system. The manufacturer shall have a documented, on-going quality assurance program
- D. **Installer Qualifications:** The manufacturer or an authorized agent of the manufacturer with not less than five years of satisfactory experience installing elevators equal in character and performance to the project elevators.
- E. **Fire-rated entrance assemblies:** Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10 (b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).
- F. **Inspection and testing:**
1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
 2. Arrange for inspections and make required tests.
 3. Deliver to the County upon completion and acceptance of elevator work.

1.5 WARRANTY

- A. **Special manufacturer's Warranty:** Manufacturer's standard form in which manufacturer agrees to restore, or replace defective elevator work within specified warranty period.
1. **Warranty Period:** Two years from date of Substantial Completion.

1.6 MAINTENANCE SERVICE

- A. **Initial Maintenance Service:** Beginning at Substantial Completion, provide two years full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. See Appendix I.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. All acceptable manufacturers are indicated in the individual equipment sections.

2.02 MATERIALS, GENERAL

- A. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

- B. Steel:
 - 1. Shapes and bars: Carbon.
 - 2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
 - 3. Finish: Factory-applied baked enamel.

- C. Stainless steel:
 - 1. Shapes and bars: No. 4 brushed or No. 8 polished stainless steel.
 - 2. Tubing: No. 4 brushed or No. 8 polished stainless steel.

- D. Aluminum:
 - 1. Extrusions: Alloy 6063

- E. Glass: Clear laminated safety glass, complying with ANSI Z97.1, nominal 9/16" thickness.

2.03 HOISTWAY EQUIPMENT

- A. Cab Platform
 - 1. Replace existing platform with new metal platform. Finish and paint all metal components with rust-proof paint.
 - 2. Replace fireproofing. Replace sub floor to create a solid substrate of marine grade wood for finished flooring material specified elsewhere. Provide new safety plate fixture and cover to match cab saddle. Check for loose welds and repair. Prevent movement of metal flooring. Ensure that installation meets fire rating requirements.

- B. Cab Sling

The cab sling shall be new. All bolts on the safety plank, stiles and crosshead will be secured. Bolster with bracing members to remove strain from the car enclosure. New sling shall be as high as clearances allow.

- C. Guide Rails

Verify condition and sizing and reuse car and counterweight guide rails if acceptable. . Provide all work necessary for smooth operation of the car and counterweight guides. Reinforce with steel brackets, tighten fishplates, guide clips and hardware and align rails. File the rails, remove rough edges and clean all surfaces. Ensure that required plumbness is maintained ($\pm 1/8"$). Provide adequate clearances for building compression.

D. Guides

1. ELSCO
2. An approved equal

Provide roller guides, with a minimum of three tires six (6) inch roller type guide on the cab sling and three (3) inch roller guide on the counterweight slings), shall be mounted on top and bottom of the car and counterweight frame and be held in contact with the guide rail by adjustable devices. Bolt guide rails to the car frame at top and bottom of the slings. The guide roller shall be designed to operate on non lubricated guide rails.

E. Buffers

Provide new spring buffers in the elevator pit. Mount buffers on new continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

F. Counterweights

Reuse counterweight and modify weights to achieve code related counterbalance. Heavier, more compact plates can be used as additional weights. The counterweight must contain the cab weight plus a percentage of the capacity (approximately 40% for traction machines). All required modifications to the counterweight must be included in price. All elevators must be completely balanced. New counterweight guards and signage shall be furnished.

G. Hoistway and Pit Lighting & Receptacles

Provide all new compact floor fixtures with guards and clear from the elevator travel path. Provide ground fault indicator (GFI) receptacles in the elevator pit, on top of elevator cab, overheads, secondary space, etc. Provide two (2) GFIs on the car top for the security system and future camera installation.

H. Emergency Terminal Limits

Place electric limit switches in the hoistway near the terminal landings. Limit switches shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing. Provide slowdown limits, normal limits and final limit switches as per code.

I. Automatic Self-Leveling

Provide each elevator car with a self-leveling device featured to automatically bring the car to the floor landings (+/- 1/4 ") and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic, accurate and independent of the operating device, provided that there is no interruption of power to the elevator. The car shall be maintained approximately level with the landing irrespective of its load or rope slippage. A pre-defined code compliant range should be arranged to safely move passengers.

J. Traveling Cables

Provide new traveling cables, properly suspended by code approved Grips or steel cores and anchored as per manufacturer recommendations. The conduit must be fire resistant and the cables shall have a proper size loop and be free from contact with the hoistway construction, car, counterweight and other equipment. For lighting circuits use 12AWG copper. All other wiring shall be 24AWG copper. All traveling cables shall contain 10% spare wires (no less than two spare wires for each type). The traveling cables shall have steel-supports and shall be run directly to the machine room, hung at the top of the hoistway at a distance of 6 feet from top of hoistway overhead. Traveling cable will be properly enclosed at the top hoistway and under the car with its steel core. Use a universal hanging system where applicable, (>200 feet). For hanging lengths of less than 200 feet, use rated grips sized for each traveler. Utilize manufacturer's installation procedure.

K. Cab Camera / Communications Wiring

Provisions shall be included for wiring for voice communication, music, cameras and monitors. Minimum Requirement (add 10% spares). The run will be from the cab bottom to the machine room and any other areas designated on any drawings or other specifications as part of this modernization, installed in separate junction boxes in all locations. The

- Two (2) pairs of Type A cables
- Two (2) (CCTV) coaxial cables, R659
- Cat 5/6 cables (network)
- Two (2) sets of twisted shielded 20 gage cables for security system.
- Two (2) sets of twisted shielded 20 gage cables for security camera.
- All switches and related equipment.

Provide switches for safe operation & maintenance of the elevator, mounted in the hoistway, pit, overhead sheave rooms, secondary spaces and machine room as well as on the elevator cab sling and enclosure shall be replaced or added new as required for the new installation and Code requirements. All stop switches must be the push/pull design.

L. Limit Switches

Provide limit switches which shall be silent when activated. All switches should be adjustable for future stopping modifications which shall conform to ANSI CODE requirements. Existing switches shall be removed. Rollers, if used, shall be equipped with engaging cams and provided with soft resilient type rollers for quiet operation. Provide terminal slow-down switches and wiring. Switches should be set to allow for a smooth stop. The normal limit switch shall be designed to bring the elevator automatically to a stop at the top and bottom terminal landings with any load up to and including 125% of the contract capacity and speed attained in normal operation. Final terminal stopping devices shall be designed to stop the car and counterweight automatically, independent of all other operating devices, but with the buffers operative. When the final terminal stopping devices operate normal operation in either direction shall be prevented. In cases where the limit cam will obstruct the pit ladder, they will be re-located to the other side of the elevator

2.04 MACHINE ROOM EQUIPMENT

Equipment that will be located in machine rooms and/or secondary shall include;

Main Machine, Motor, Brake, Sheaves & Wire Ropes, Emergency Brake/Rope Gripper, Controller, Dispatcher, Selector, Control Equipment (Drives, Motor Generators) Governors and Mainline Switches.

Machine Beams: Review adequacy of support beams, angles, plates, bearing plates, blocking steel members and all structured members. Any alterations required to properly support machine, governors, deflector and overhead sheaves shall be provided. Provide additional anchor bolts, templates and support beams for machine as required. Provide and related support steel. All bearings, steel, plates, mounting steel modifications and sheaves shall be included in the installation of the machine.

A. Isolation

Provide proper isolation for all mechanical and electrical equipment and any structural components, to prevent vibration, harmonic distortion, mechanical and electrical noise, audible noise and radio frequency interference to within acceptable limits of applicable code(s).

B. Labeling

Identify machine room components by number, as required by applicable codes and local regulations. All elevators, which have a designated device number by the Elevator Division of the Department of Buildings, must have a metal tag on all machine room equipment. This tag shall be in block type with a minimum of 1/4" height and securely attached in a permanent manner to the driving machine, controller, motor generator set or drive unit and the disconnecting means.

In addition, each elevator component shall be painted with the designated elevator letter. Each letter shall be four (4) inches in height and shall be located in a manner that recognition can be made from any area within the machine room.

C. Disconnect Switch(es) – Main Line

The main machine shall be visible from the main line switch. The main line switch shall conform to all codes and authorities having jurisdiction. The main line will have sufficient amperage to provide for all elevator equipment without overloading any piece of equipment. The main line disconnect will have proper breakers and shall be lockable in the open position. Contractor is to verify all power characteristics for proper sizing of the equipment.

D. Lighting – Machine Room

The contractor will provide new fixtures that will provide adequate illumination intensity for safe movement and to perform needed work on machine room equipment as shown on drawings. A switch shall be installed and located next to the machine room entrance which will control the lights. Light fixtures shall be installed above each piece of equipment such as machine, controller, governor and mainline switch panel to achieve properly distributed illumination for all equipment.

The contractor will provide an auxiliary disconnect as per code for cab lighting.

E. Electrical

Contractor shall review and test as necessary to verify the general compliance and sufficiency of electrical service and conformity with applicable codes. Breakers (Fusing) must be code compliant. Existing grounding, feeding service and distribution in the elevator machine room shall be reviewed and upgraded as per code and equipment requirements. Although the electric power supply details are provided elsewhere in these specifications, it is the responsibility of the elevator contractor to take all readings and measurements with proper instruments to determine actual electric loads of existing equipment. This information will be utilized to design and size the proposed new equipment by the contractor based upon actual current and voltages to prevent electrical tripping and elevator shutdowns with new equipment.

F. Load Test

Prior to commencement of cab work a balanced load test must be performed on the elevator. If multiple elevators are present, a typical elevator per bank shall be selected. The results of this test shall be included with submittals and should include the individual weights of the cab & counterweight prior to modernization. The results shall also include calculations of car and counterweight loads and how the code required percentage of rated capacity is achieved. The Contractor shall include the cost associated with replacing the counterweight frame in their bid as a separate item if required.

Counterweight modifications that make the existing frame unusable, non code complaint or cause building reactions to change more than 5% shall be brought to the attention of the Architect.

G. Main Machine

1. Hollister Whitney
2. An approved Equal

Furnish and install new gearless traction hoist machines. The hoisting machine shall be a gearless traction type, consisting of new AC motor, new brake, gear assembly in a gearbox and new driving sheave mounted in alignment on a new rigid, common bedplate. A large diameter, forged shaft shall serve as a support for the motor armature and for the removable drive sheave and brake drum/disc. It shall be supported by roller bearings. Steel deflector sheaves of adequate diameter and strength shall be provided. All bearings shall be included and shall be ball bearing type. The grease fittings shall be easily accessible. All cables and guards shall be provided as per Code.

The drive sheave will be cast from high metal grade. (Brinell hardness: 215 to 230). Accurate machining will be done to provide grooves of proper depth and shape. Ensure maximum traction with a minimum of cable and sheave wear. Ball bearings shall be provided.

The Machine shall be mounted in a machine room directly over the elevator on structural steel beams or channels and bearing plates furnished by the elevator installer. Beams shall be securely fastened to the supports supplied by other trades.

H. Drive System

Provide a new solid-state drive system as follows:

1. The drive system shall be of the non-regenerative Variable Frequency type.
2. The system shall be a vector controlled pulse-width modulated AC drive. The variable voltage variable frequency drive shall convert the AC power supply using a two step process to a variable voltage variable frequency power supply for use by the hoist motor.
3. The speed control shall be by means of vector control providing independent excitation and torque current. A digital absolute velocity encoder shall be provided giving feedback to the controller on armature position and motor speed.
4. Provide suitable chokes/filters to keep harmonics (electrical and acoustic) to within limits for residential buildings mandated by NEC/IEEE and OSHA.

I. Motor

The motor shall be designed for use with the elevator and have class "F" insulation. The motor armature shall be dynamically balanced and supported by roller bearings of ample capacity. The armature and driving sheave shall be properly balanced for smooth, high-speed elevator performance. The motor will be fully reversible, have low starting torque and starting current. The motor shall be rated in accordance with the standards of the AIEE. The motor must be of 30 horse power and designed to have the capacity to operate the elevator at rated contract load and speed without overheating. During operation with the controller, the rated speed shall remain constant plus or minus 5% under all loads in the specified range. The motor shall be designed, balanced & aligned with the brake pulley to prevent vibration.

J. Brake

The brake shall be a spring applied electric brake; held open by an electro-magnet actuated by a digital brake controller and designed to work as an integral part of the motor controller to provide smooth positive stops. The Brake shall be designed to automatically apply in the event of interruption of power supply from any cause. Operation and control of the brake shall be all digital. The setting and lifting of the brake shall be software based and all electronic. All adjustments and setup of the brake shall be made using a PC interface. No contactors or resistors shall be used in the actuation of the brake. A new electromechanical disc brake shall be provided on the machines. The new brake shall be spring applied and electrically activated. Brake shoes shall be applied to the braking areas simultaneously and with even pressure by means of helical compression springs. An electro magnet shall be used for fast release and for gradual smooth operation of shoes. The brake shall be able to hold 125% of the elevator capacity. The contractor shall provide all necessary machine supports and anchoring. Brake switches are required to monitor brake activation.

K. Ropes:

1. Bethlehem Steel
2. An approved Equal

Properly designed steel hoist ropes of size and number to ensure proper wear qualities shall be used. Cables designed for elevator use with ANSI Code mandated safety ratings for the elevator speed and capacity must be used. Wedge shackles and springs designed for use with steel ropes shall be used for securing purposes as per code. Anti-spin devices shall be used. (1/8" stiff cable shall be used and secured with two (2) Crosby Clips on both the car and counterweight. New hitch plates on the car and counterweight sling shall also be provided by the elevator contractor. Hoist rope data shall be marked on the crosshead data plate and rope tag. Furnish adequate compensation for weight of hoist ropes when required to maintain proper counterbalance ratio.

Governor rope shall be 3/8" iron.

L. Emergency Brake

1. GAL /Hollister Whitney
2. An approved Equal

Provide an emergency brake to grab elevator suspension ropes to stop the elevator in the event of a mechanical or electrical failure. If an ascending elevator overspeeds in the up direction and also if the elevator leaves the floor with the doors opened this device will be activated as per code requirements.

M. Safety and Governor

1. GAL /Hollister Whitney
2. Approved Equal

All safety devices shall be replaced with new. All safeties shall be completely tested before any elevator is restored to service. All missing or worn parts/hardware shall be replaced. Car safety shall be mounted on the bottom members of the car frame and be operated by a centrifugal speed governor and tension sheave assembly. Governor rope shall be 3/8" iron. The governor shall be designed to cut off power to the motor and apply the brake whenever the governor indicates the car has excessive speed. The governor shall function when the car over speeds in either the up or down direction. The governor will be mounted above the car. The proper tension in the governor rope shall be maintained by the weighted tension sheave located in the pit. The governor shall be equipped with rope grip jaws designed to clamp the governor rope so as to actuate the car safety upon a predetermined overspeed in either direction. Overspeed setting >115% of specified rated car speed and < the maximum governor tripping speed specified in the applicable elevator Code for the specified rated car speed. When operated, no undue damage to the governor rope shall result from the stopping action. Adjust the governor and mark the tripping speed specified on the tag.

2.05 HOISTWAY ENTRANCES

A. Doors and Frames

All existing shaftway door entrances/frames and doors shall be reused. Stops, pockets, sight guards and appurtenances at all floors on all panels shall be replaced new. Fascias and dust covers shall be installed on all floors. Hatchway door sight guards shall be secured on all doors as needed. All entrance panels and frames shall be thoroughly cleaned. All unused key access holes shall be plugged & sealed. Kick blocks on entrance saddles and "Z" brackets shall be installed on all hatchway door panels (8"). New gibs and brackets shall be provided at the bottom of each door and engage the sill at least 1/4 of an inch as required by Code. Doors shall include service or emergency key ways to meet all code requirements. All door jambs shall have the correct door jamb markings located on both sides of the door jamb. Provide new accessories as needed.

B. Interlocks

Equip each hoistway entrance with new approved type interlock, tested as required by code. Interlock shall be designed to prevent the opening the doors at any landing from the corridor side unless the car is at rest at that landing or is in the leveling zone and stopping at that landing. The operation of the elevator driving machine shall be prevented by means of opening the safety circuit, unless the shaftway door is locked in the closed position, except when the car is in the landing zone and is either stopped or being stopped. Interlocks shall be so located that they are not accessible from the landing side of the shaftway doors. Hoistway door unlocking devices shall be provided and be of the type specified by the governing code. All hoistway interlocks, contacts and unlocking devices shall have met all applicable functional and engineering tests required by the applicable elevator Code and all such equipment shall have been certified by a competent approved laboratory.

C. Door Hanger and Tracks, Sheaves, Closers, Rollers, Fascias, Astragals, Door Bumpers, Guards, Gibs, Dust Covers, Sight Guards, Jamb Markings, etc.-Remove and replace with new.

Provide new hoistway door equipment and accessories on all doors. Damaged stainless steel sills will be replaced with new with proper supports. New vision glass guards permanently attached to each hatchway door will be installed. All cab and hatchway door Astragals shall be replaced.

D. Hoistway Sills

Clean and Retain. Damaged sills will be replaced. Note number of sills included in bid. If no sills are noted in the bid, it will be assumed that all hoistway sills are being replaced.

2.06 PASSENGER ELEVATOR CAR ENCLOSURE (see architect drawings)**A. Cab Dimensions: 48”X66”X88”H- 36” Single Speed Doors, 84” H****B. Increase height of the cab by 12 inches or maximum available while meeting code required clearances.****C. Car Enclosure - General**

1. Based upon Preliminary Balance Load Test results the contractor shall determine the maximum cab weight that can be installed without requiring a new counterweight frame, without exceeding the load rating of the equipment, or without violating requirements of the Code.
2. Reinstall all equipment that is being retained. Provide and connect new elevator equipment being installed in the cab.
3. It is the responsibility of the Contractor to insure that all alterations shall not increase the original building design reactions by more than 5%.
4. Conduct final balanced load test when all work has been completed.
5. Contractor shall statically balance the cab after refurbishment is completed.
6. All coordination.
7. Related work not specifically mentioned above to ensure a complete cab installation.

D. Cab Enclosure (see architect drawings)

1. Provide a cab based upon information specified herein to ensure timely communication and completion. If necessary, visit the County/Architect along with samples, designs and renderings based upon allowance to facilitate cab selection.
2. Hanging cab wall pads: One (1) set per elevator durable and padded with durable masonite. The pads shall be designed to protect the cab interior during equipment moves. All accessories required for building personnel to hang pads must be included in each set.
3. Lighting: As indicated on drawings.

4. Cab Door: Provide new cab door panel constructed in rigid steel or aluminum. Panel shall be 14 gauge furniture steel or aluminum. All bolt hole patterns shall be pre-drilled and tapped. Provide "Z" brackets, Code mandated gibs & kick blocks.
 5. Ventilation, Entrance Columns, Frieze Panels, base wainscoting, transoms & other design details.
 6. Finish selection. Cab walls shall be of Stainless Steel #4 finish. 1/8" stainless steel diamond plate panels will be fastened to all the walls. Each wall will have two section vertically separated. These plates shall be properly secured in a manner that can be easily removed for future replacement. Cab flooring shall be 1/4" Stainless Steel Diamondplate.
- E. Contractor shall include all work and cab-related equipment specified elsewhere in this specification, as well as the following:
1. Permits, tests, fees, and all other costs required by the authorities having jurisdiction to complete the installation according to Code.
 2. Flooring, Sub-Flooring, Sill (Saddle).
 3. Car Door Hangers
 4. Switches, Emergency Exit Switches.
- F. Cab Saddle
The elevator contractor shall install new nickel silver cab saddles or as per drawings.
- G. Car Top Inspection
Provide a car top inspection station with an "Emergency Stop" and Inspection/Automatic switch and constant pressure "safe", "up" and "down" direction buttons. The Inspection switch shall make the normal operating devices inoperative (including Fire Recall) when in the Inspection position and give the operator complete control of the elevator. Mount the car top inspection station to the cab crosshead or make it portable with a permanent and safe electrical cord. A minimum of two (2) lights, with an on/off switch and guard with a minimum of code required brightness, fire buzzer and light inspection switches.
- H. Emergency Exits
The cab shall have an emergency exit on the top of the cab enclosure as per code. Mechanical locks shall be provided so that elevator passengers cannot exit without assistance. Provide fastening mechanism to anchor the hatch to the top of cab.
- I. Signage
All elevator cabs shall be equipped with all code required signage. The following signs shall be engraved directly on to the cab pushbutton panels.
ID#, Capacity, No Smoking, Inspection Certificate Location, Direction for Fireman's Recall, Direction for Operating Communication System, Signage required by County or current code.

2.07 DOOR OPERATION

A. Door Operator

Provide a direct or alternating current motor driven heavy duty solid state double closed loop operator designed to operate the car and hoistway doors simultaneously smoothly without a slam in both directions. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. In event of power failure, the mechanical door operating mechanism shall be arranged for instantaneous manual operation of car door and the hoistway

door The hoistway door shall continue during emergency operation to be self-locking and self-closing. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. The door shall be designed to operate at an average opening speed for 2 feet per second. This closing door speed must be adjustable keep the Kinetic Energy striking force to within industry standards. Provide rubber bumpers at both ends. Interlocks and safety contacts shall be provided.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel will reverse and the door will reopen to answer the other call.
4. Nudging Operation (Must have on/off capability. Keep normally off & turn on at County's request). The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.
5. Limited Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Car Door Operator Accessories

Provide new car door hanger track assemblies and header which shall be of the heavy duty type. All door accessories shall be approved. Two, two-point suspension sheave hanger roller assemblies, with related operating linkages, gate switch, clutch, zone lock and accessories shall conform to the applicable elevator Code requirements.

C. Door Protection Device:

1. Tritronic
2. An approved Equal

Provide a waterproof door protection system using 150 or more microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen. The device shall be designed and adjusted to minimize the possibility of injury to passengers and shall not project into hoistway door opening. A mechanical reopening device shall not be acceptable.

2.08 CAR OPERATING STATION

The car station buttons shall become individually illuminated with L.E.D. type bulbs as a button for the desired floor is pressed. These lights shall be extinguished as the call is answered, or the demand is satisfied.

The alarm button with acknowledgement light and red emergency stop switch shall be located 35 inches from the floor, and control buttons not more than 54 inches from the floor. Activation of the stop switch shall not cancel the registered car or corridor calls, and after the switch is released, the car shall continue to answer its registered. The entire system shall comply with all authorities having jurisdiction.

- A. Car Operating Station: The main car control in each car shall contain the devices required for specific operation. An inspection switch to make normal operation inoperative and allow use of the top-of-car operating station shall be provided. All switches not normally used shall be located behind a locked hinged panel. The following switches will also be provided; light, inspection, emergency light test, as well as a 110 A.C. outlet, 2-speed fan, attendant switch, up, down, and pass buttons, as well as all firemen's recall devices.

The panel shall consist of the following pushbuttons, key switches and indicators:

1. The bottom of the Car Operating Station shall contain a functional "door open," "door close," "alarm" buttons and a keyed "emergency stop" switch.
2. The Intermediate area of the station shall contain floor buttons which illuminate when a call is registered and remain illuminated until the call is answered. Raised floor indications and handicap symbols shall be located to the left and immediately adjacent to the floor buttons. No applied symbols or floor indications or symbols on the buttons shall be permitted.
3. The next level shall contain supplied options switches.
4. The top of the Car Operating Station shall contain fire service features, including operating instructions, in accordance with ASME A17.1 and local code.

A sounding button shall also be included on each cab panel to allow handicap persons the options of sounding an audible signal when passing each floor. Contractor must include all costs to modify cab wall to accommodate the new position of car station if existing cabs are being retained. The communication system will be provided with visual acknowledgements for the deaf.

- B. Position Indicator: A position indicator shall be contained above floor push buttons. As the car travels, its position in the hoistway shall be indicated by the illumination of the alpha/numeric character corresponding to the landing which the elevator is stopped at or passing.
- C. Column Mounted Car Traveling Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound and illuminate when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close. The direction arrows shall be equipped with chimes, to indicate the direction that the car is traveling. An adjustable electronic chime shall be incorporated in the fixtures to sound as it is illuminated to call the attention of the waiting passengers. The arrows and electronic adjustable tone devices shall comply with applicable elevator Code requirements.

- D. **Emergency Light:** Self-powered emergency light with an extra long life power-pack (rechargeable battery and automatic charger). The emergency light system may be incorporated into the cab pushbutton panel or as an alternate the emergency lighting system shall be designed to keep some ceiling lights on. The panel emergency light shall consist of white LED's and be capable of putting out a minimum of four (4) foot candles, one foot out and four foot in front of the car swing panel. The emergency light will illuminate automatically upon loss of the building's normal power supply. The system shall operate automatically when power failure is sensed. Any relocation or design change of this panel shall be included by the elevator contractor.
- E. **Communications:**
Ring Communications
An Approved Equal
 Provide an emergency communications device mounted integrally within the car station which shall include be a speaker in the cab pushbutton panel and an auto-dialer system. A two-way communications means between the car and a location in the building that is readily accessible to authorized and emergency personnel shall be provided. Means shall be provided to enable two-way voice communication between the machine room and the interior of the car. Location and type of system will be as per industry standards and subject to approval. The system shall be completely wired including all wiring, conduits electric, fittings, etc. Prior to modernization, the County retains the right to relocate the communication system.
 The following will be furnished and installed: RMS 5000 EX with battery backup, Wall mounted unit, Two (2) AA916s for the machine room and security station for desk, AA 916 master station, and Car station mounted unit SS900B and AN 913 and Dialer DNA 934P. Telephone line will be connected to RMS 5000RX.
- F. **Include the following special controls:**
1. Independent service switch.
 2. Inspection switch.
 3. Two speed fan/light switch.
 4. Certificate frame.

2.09 CONTROL SYSTEMS

1. Motion Control Engineering
 2. GAL
 3. ESI
 4. Swift
 5. An approved Equal
- A. **Controller:** The elevator control system shall be microprocessor based and software oriented. The system shall operate in real time, continuously analyzing the car(s) changing position, condition, and work load. All controller and operational circuits including the brake control and drive system shall be digital. Control of the elevator shall be automatic in operation by means of push buttons in the car operating panel numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings
1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
 2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is

at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.

3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
4. A car that is stopping for the last hall call in the preference direction and that hall call is for the opposite direction with no onward car calls, shall reverse preference when the selector position advances to the landing at which the car is committed to stop. A car that is stopping for the last hall call in the preference direction, and that hall call is for the same direction, shall hold its preference until the door is almost closed allowing time for a passenger to register an onward car call which will maintain the preference. If no car call is registered before the door is almost closed, the car will lose its preference and shall be available to accept calls in either direction.]

B. Operation:

Duplex Operation- side-by-side elevators: Where group operation is required, the group supervisory operation shall be embedded within car controllers. No separate group controller shall be supplied. The microprocessor shall constantly scan the system for hall calls. When hall calls are registered, the control system shall immediately calculate the estimated time of arrival using such information as, number of floors to travel from the current position, the time it takes to travel one floor at top speed, calls assigned to a car, and car reversal time to respond to a call in the opposite direction of travel. When a car's status changes or additional hall calls are registered, the estimated time of arrival shall be recalculated and calls reassigned if necessary.

1. Traffic Pattern: The microprocessor shall provide flexibility to meet well defined patterns of traffic, including up peak, down peak, and heavy interfloor demands, and adjust for indeterminate variations in these patterns which occur in buildings.

C. Load Weighing Device: Provide a load weighing device on each car which, when the particular car is filled to an adjustable percentage of the capacity load, shall cause the car to bypass landing calls but not car calls. The passed landing calls shall remain registered for the next following car.

1. The device shall be unaffected by the action of compensating chain or rope. The device shall detect a 15 pound (7 Kg.) load change under all conditions.
2. The load sensor shall use a linear variable differential transformer to accurately measure the weight in the car. The information shall be transferred via a serial link to the elevator controller.

D. Anti-Nuisance Call Control: The microprocessor control system shall evaluate the number of people on the car and compare that value to the number of car calls registered. If the number of car calls exceeds the number of people by a field programmable value, the car calls shall be canceled after the first call has been answered.

E. Position Selector: The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slow down points in memory.

F. Motion Control: The drive control system shall be dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit continuous comparison of

machine speed to velocity profile and to actual car speed. This accurate position/velocity feedback shall permit a fast and accurate control of acceleration and retardation.'

- G. Motor Pre-Torque: Current shall be applied to the elevator drive before the brake is released and the speed pattern is dictated to eliminate roll back and sling shot effects of unbalanced loads in the car. The electronic load weighing system shall determine the load on the car which will be used in determining a pre-torque reference to send to the drive.
- H. Emergency Power Operation: Upon loss of normal power, building-supplied standby power is available to the elevator on the same wires as the normal power.. Once the loss of normal power has been detected and standby power is available, one elevator at a time from each group will be lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed and the car shuts down. The next available car in the group will then be selected to lower, allow passengers to exit, close the doors and shutdown. This process is repeated until all cars in the group have been lowered and parked. At this time, an elevator is automatically allowed to continue service using the building-supplied standby power. A manual selection switch is available to override the automatic selection and allow and car in the group to provide service to the building. When normal power is restored, the elevators automatically resume operation.

2.09 HALL STATIONS

- A. Hall Stations: Provide ADA compliant, "top of the line" buttons (subject to County approval) with red-illuminating LED halos to indicate that a call has been registered at that floor for the indicated direction. Provide engraving on hall buttons. Each terminal station shall contain one illuminating push button. Those lights shall operate individually to indicate that a call has been registered. The lights shall extinguish as the calls are answered.
 1. Each intermediate station shall consist of two illuminating pushbuttons, one for the up direction and one for the down position.
 2. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

As necessary for ADA height existing hall buttons located in the door frame shall be relocated and existing boxes patched with steel plates filled, sanded, and made smooth for painting or a flush mounted extender plate shall be installed. Provide a new cutout in adjacent wall to accommodate the new hall button box and plate.

- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements and, when required by local code: Section 407 in ICC A117.1.
- C. Hall Position Indicator: Provide illuminating LED indicators on each floor.

2.10 HOISTWAY PIT

- A. Pit Ladders
Provide pit ladders in accordance with Code.
- B. Locate the ladder so as not to obstruct elevator operation.

- C. Pit Drain/sump pump.
See MEP scope.
- 2.11 **Electrical Wiring**
Provide new wiring as per applicable edition of National Electrical Code. Replace all rusted conduit, boxes and flexible raceway must be replaced new. Terminal connections for all conductors at equipment panels, center of hoistway terminal blocks or studs shall have identifying numbers. Provide all wiring from the controller, selector, dispatching panels. Wiring shall be properly insulated and have flame-retarding and moisture-resisting outer cover and shall be run in galvanized metallic conduit or duct, using strain boxes as required. Each device will have a ground stud with grounding returning back to the controller.
Provide lighting in pit as per code.
- 2.12 **Venting**
Machine Room: Elevator machine rooms that contain solid-state equipment for elevator operation shall be provided with independent ventilation or air-conditioning system to protect against the overheating of the electrical equipment. The system shall be thermostatically controlled and capable of maintaining temperatures within the range established for the elevator equipment which will be stipulated by the selected manufacturer. (Typically 20,000 Btu).
Hoistway: Provide venting of the hoistway to the outside to meet applicable code requirements. The vent area shall be 3 ½ % of the cross sectional area of the elevator hoistway but not less than 3 square feet. The existing vent holes in the machine room shall be ducted to the outside by provide openings in the machine room wall that shall be properly anchored with lintels. Dampers shall be provided on the vent opening that will be activated by a smoke detector installed at the top of the hoistway. Provide louvers and bird/rodent screen on the outside of the controlled by a thermostat and dampers as indicated on the drawings. Provide adequate fireproofing and grouting to cover all unused openings.
- 2.13 **Emergency or Standby Power:** This elevator shall be capable of operating on emergency power supplied by the building in the event of a power failure as per building code requirements. The emergency power system shall be capable of operating the elevator with rated load, at least one at a time. The transfer between the normal and the emergency or standby power system shall be automatic.
An illuminated signal marked "ELEVATOR EMERGENCY POWER" shall be provided in the elevator lobby at the designated level to indicate that the normal power supply has failed and the emergency or standby power is in effect.
Firefighters' Emergency Operation shall apply to all automatic elevators as per code.
- 2.13 Provide emergency battery device to safely move the elevator to the next landing and open the doors.
- 2.14 Provide any other switch/component required by current code.

PART 3 - EXECUTION

3.1 EXAMINATION & DEMOLITION

- A. All existing equipment that is listed in Part 2 as being replaced as part of this modernization must be properly removed and disposed of in strict accordance with all codes.

- B. Before starting elevator installation, inspect hoistway, hoistway openings, pits and machine rooms, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- C. Commencement of installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 INSTALLATION

- A. Install elevator systems components:
 - 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 - 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. Schedule work in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- F. Phasing of all work shall be coordinated with County Construction Coordinator prior to commencing any work. All necessary permissions shall be obtained prior to commencement of work.
- G. Unless authorized in writing otherwise, all work shall be done on Monday through Friday only, 7:30AM to 4:00 PM, excluding holidays.
- H. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.
- I. Sound isolation: Mount rotating and vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent the transmission of vibrations to the structure, and eliminate sources of structure-borne noise from the elevator system.
- J. Alignment: Coordinate modification of hoistway entrances and elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- K. Remove all old unused pipes wires and ducts and patch any damage caused by removal.
- L. Patch holes in hoistway.

- M. Bevel all ledges in hoistway as per code.
- N. Lubricate operating parts of system, including ropes, as recommended by the manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.
- B. Advise County, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.4 ADJUSTING

Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.5 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; shall not be cleaned with bleach-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

3.6 PROTECTION

At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.7 DEMONSTRATION

- A. Instruct County's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train County's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with County's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.8 Fireman Recall Key Switches & Operation

Fireman Recall buttons and key switches that will function in conjunction with the Fireman's Recall System will be provided in the Car Station and Lobby Hall Station. This will meet the latest New York State & City of New York Fire Codes and any code changes that occur during modernization shall be retroactive .

Emergency Fire Operation shall be designed to meet current code for Phase I & II operation. Emergency Operation shall equip the elevator with a control system to operate under, and/or recall the cars in fire or other emergency condition. All the features shall meet with the governing Firemen's Recall codes and Local Building codes. Emergency return to the lobby shall also be initiated with the Fire Emergency Procedures.

3.9 Independent Service

Provide independent service by providing the operating panel with a key operated switch. This key shall permit the car to by-pass all corridor calls and permit dispatching of the car directly to any floor by pressing the corresponding car button, when closed. The door shall not close until a car button is pressed or until the key operated switch is opened. Normal service shall resume, when key switched is opened.

3.10 Handicapped Requirements

- A. The American Disabilities Act (ADA), NYC Handicapped Code and other applicable requirements shall be complied with on all aspects of the Elevator Modernization.
- B. Alarm bell button and elevator emergency stop switch > 35 inches from floor level, and < 54 inches from the floor level.
- C. Braille markings shall be provided adjacent to the floor and control buttons on the car station panel. They shall be contrasting color background to the left of each button.
- D. All letters and numbers shall be a minimum of 5/8" and raised .03".
- E. The centerline of the hall pushbutton station shall be 42" above the floor when mounting boxes are replaced.
- F. The elevator directional lanterns illuminate their respective directions and sound once for the "up" direction and twice for the "down" direction. The elevator shall have an audible signal to tell passengers that the car is stopping or passing a floor served by the elevator.
- G. On each floor landing, "Designations Signs" shall be placed on all entrances on both sides of jamb at a height of 60" above the floor.
- H. Designations Signs shall be 2" high, raised .03".
- I. An outside communication system shall be provided and installed by the contractor if the building does not have 24-hour building attendant.

APPENDIX I

GENERAL INFORMATION:

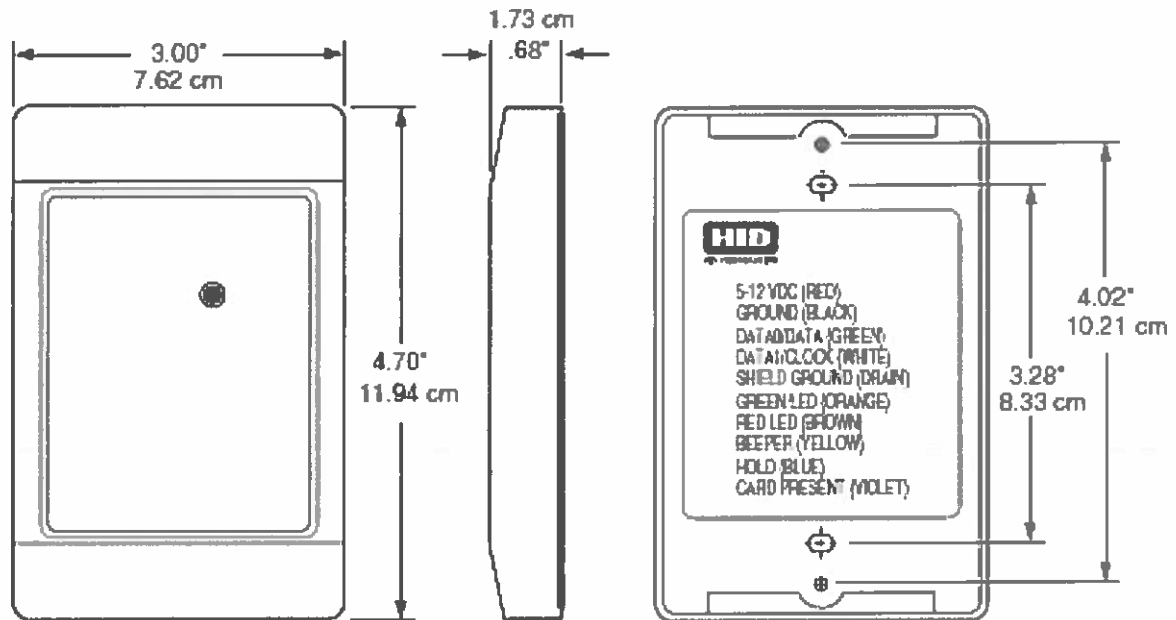
Elevator #	ID#	Classification	Rated Speed (Feet Per Minute) FPM	Capacity (lbs)	Machine Type	Floors Served
110 DR. MARTIN LUTHER KING BOULEVARD. WHITE PLAINS, NY						
3	Freight	Passenger	200	2,500	Basement Geared	B-4

EQUIPMENT LOCATION:

Elevator #	Machine Room	Secondary	Rail Contact	Pit	Buffer Type	Compensation Means
110 DR. MARTIN LUTHER KING BOULEVARD. WHITE PLAINS, NY						
3	Basement	N/A	Roller Guides	Standard	Spring	N/A

MECHANICAL, ELECTRICAL, & DATA TAG INFORMATION

110 DR. MARTIN LUTHER KING BOULEVARD. WHITE PLAINS, NY	
Elevator ID: Passenger Elevator	
<u>Main Line Amperage:</u>	100 Amps
<u>Fire Extinguisher Details</u>	Current
<u>HVAC</u>	Venting not per current code Separate Heater and Split System Air Conditioner in Machine Room.
<u>Smoke Detector</u>	Machine Room
<u>Pit Sump Pump</u>	Yes (appears to be non-functional)
<u>Emergency Communications</u>	Yes
Machine	
Type:	Basement Geared Traction
Capacity:	2,500 lbs
Speed:	200 FPM
Controller:	
Type:	Variable Voltage
Model:	VV- 459
Volts/ Phase:	208 Volts, 3 Phase
Power	25 HP
Year/Date Installed:	6/10/1992
Motor:	
Type:	X3640
RPM	850
Amperage:	25/18
Voltage:	230
Horse Power:	25HP
Phase:	3
Frequency:	60
Generator:	
Power	25 HP
RPM	1750
Voltage	240V 15 kW
Governor Details	
Tripping Speed:	250 FPM
Cable Size:	3/8"
Test Data	Five Year -2-2018

APPENDIX II**SECURITY CARD READER SYSTEM****ELEVATOR CONTRACTOR SCOPE OF WORK FOR CARD READER SYSTEM:**

- Provide additional wiring in traveling cables – see Specification Sections 2.03 K and 2.03L
- Cutouts and back boxes in hall call stations to incorporate above card reader dimensions.
- Cutouts and back boxes in car station to incorporate above card reader dimensions.
- Provide relay in machine room/controller for 12/24VDC for relaying interface equipment.
- Install an RM4 box supplied by security contractor on top of car using manufacturer recommended procedures.
- Provide dry contact in machine room.
- Provide additional wiring in separate conduit to each hall station for card reader.

SECTION 142150 – ELEVATOR MODERNIZATION**PART 1 - GENERAL****1.1 SUMMARY****A. This Section includes the following:**

1. Elevator Modernization
2. Card Reader Security System Details and Scope of Work – Appendix II

Note: Drawings are provided separately. In the event of any real or apparent conflict in the scope of work, the more stringent conditions shall apply.

1.2 SCHEDULE OF ELEVATOR(S)**One (1) Passenger Elevator**

See detailed information provided on Appendix I

1.3 SUBMITTALS

- A. Product Data:** Include capacities, sizes, performances, operations, safety features, finishes and similar information.
- B. Shop Drawings:** Show plans, elevations, sections and large scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Indicate loads imposed on building structure at points of support, and maximum and average power demands.
No general submissions will be made. Details if equipment that is directly proposed for the job shall be submitted. All submissions will be made in binders that must be appropriately formatted.

List of Submittals

- MAIN LINE DISCONNECT
- MACHINE – BRAKE, SHEAVES, WIRE ROPES
- HOIST MOTOR
- CONTROLLER SELECTOR & DISPATCHER -
- OPERATION, CONTROL, AND SIGNAL SYSTEMS.
- MOTOR CONTROL & DRIVE UNIT
- GOVERNOR & TENSION SHEAVE
- COUNTERWEIGHT ASSEMBLY
- PLATFORM, SLING & SAFETY
- ELEVATOR CAR ENCLOSURES & HOISTWAY ENTRANCES.
- DETECTOR EDGE
- “Z” BRACKET

- DOOR OPERATOR, TOP OF CAR INSPECTION STATION, CAB DOOR AND HOISTWAY EQUIPMENT
- LIGHTING FIXTURES
- LIMITS & LIMIT SWITCHES
- SILLS AND SADDLES
- EMERGENCY BRAKE
- ROLLER GUIDES / SHOES
- EMERGENCY POWER UNIT & ALARM BELL
- BUFFERS
- OTHER MAJOR EQUIPMENT NOT LISTED

List of Initial Project Submittals as applicable (at least three (3) sets):

- A separate page listing the manufacturers of proposed equipment for approval with the bid package.
- This list will also include names of all subcontractors, organizations or individuals not directly employed by the contractor that will be involved with the project. Provide description of proposed work.
- Shop drawings:
 - Show equipment arrangement in the machine room, corridor, pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
 - Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
 - Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
 - Indicate electrical power requirements & branch circuit protection device recommendations.
 - Layout drawings indicating the location of all equipment, switches, limits and electrical sources
- Information Required on Layout Drawings
Elevator layout drawings shall, in addition to other data, indicate the following:
 - (a) the maximum bracket spacing
 - (b) the estimated maximum vertical forces on the guide rails on application of the safety .
 - (c) in the case of freight elevators for Class B or C loading , the horizontal forces on the guiderail faces during loading and unloading, and the estimated maximum horizontal forces in a post-wise direction on the guide-rail faces on the application of the safety device
 - (d) the size and linear weight kg/m (lb/ft) of any rail reinforcement, where provided
 - (e) the total static and impact loads imposed on machinery and sheave beams, supports, and floors or foundations
 - (f) the impact load on buffer supports due to buffer engagement at the maximum permissible speed and load.
 - (g) where compensation tie-down is applied , the load on the compensation tie-down supports
 - (h) the total static and dynamic loads from the governor, ropes, and tension system
 - (i) the horizontal forces on the building
- Cab and Counterweight load calculations including differential weights and details of what work needs to be performed to achieve code mandated counterbalance and changes to building reactions.
- Power requirements for the elevator(s) and individual major equipment. Heat outputs of machine room equipment to size HVAC equipment.
- Cab and Hallway fixture details, including color swatches and finish samples. Samples must at a minimum, include buttons, tags, jamb markers, cab material, entrance and signal fixture and edging.
- Wiring diagrams & equipment cut sheets.
- A detailed schedule to be submitted which must include the following:
- Equipment lead times after approval.

- Detailed breakdown of tasks
- Any County items (fire extinguisher, power, main line, communications line, lighting, etc)
- Cab drawings and details of walls ceiling & flooring. Provide finished cab weight & weight differential.
- Hoistway entrance details.
- Technical details of drives, controls, selector, dispatcher and sequence of operation.
- Prior to commencement, elevator & electrical permits filed with the Department of buildings.

C. Samples: For Exposed finishes

D. Manufacturer Certificates: Signed by Elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

E. Operation and Maintenance data.

F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with ASME A17.1 (latest applicable version) and elevator design requirements for earthquake loads in ASCE 7

B. APPLICABLE CODES, STANDARDS, AND PUBLICATIONS

- Latest version of ASME A17.1 2016 with amendments.
- National Electronic Code NFPA 70.
- Life Safety Code, NFPA 101.
- Specifications and references in this Section do not supplant any code requirements governing the design, fabrication, installation or operation of the equipment.
In case of any conflict in applicable codes, regulations or standards, the most stringent requirement shall take precedent.
- The elevator supplier shall be licensed and governed by local and governmental authorities.
- ASME -American Society of Mechanical Engineers / ANSI -American National Standards Institute
 - ANSI A117
 - White Plains Vertical Transportation Code.
- New York State Building Code
- White Plains Building Code
- Uniform Building Code and Local Building Codes – Applicable versions in effect at the time of filing.
- The NY State Electrical Code & National Electric Code (NEC) by reference
- Industry Standard Publications by George Strakosch, where applicable.
- National Fire Protection Association (NFPA).
- The National Electrical Code
- Fire Safety of Hoistway Entrances.
- Life Safety Code
- OSHA – Occupational Safety and Hazard Administration
- Americans with Disabilities Act (ADA) Application Guidelines
- Environmental Protection Agency (EPA)

- Building Officials and Code Administrators - Building Code
 - IEEE - Institute of Electrical and Electronics Engineers, Inc.
 - Other Codes as applicable
- C. **Manufacturer Qualifications:** A manufacturer regularly engaged in manufacturing, installing, and servicing elevators of the type required for the project. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment. The major parts of the elevator equipment shall be manufactured by the manufacturing company, and not be an assembled system. The manufacturer shall have a documented, on-going quality assurance program
- D. **Installer Qualifications:** The manufacturer or an authorized agent of the manufacturer with not less than five years of satisfactory experience installing elevators equal in character and performance to the project elevators.
- E. **Fire-rated entrance assemblies:** Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10 (b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).
- F. **Inspection and testing:**
1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
 2. Arrange for inspections and make required tests.
 3. Deliver to the County upon completion and acceptance of elevator work.

1.5 WARRANTY

- A. **Special manufacturer's Warranty:** Manufacturer's standard form in which manufacturer agrees to restore, or replace defective elevator work within specified warranty period.
1. **Warranty Period:** Two years from date of Substantial Completion.

1.6 MAINTENANCE SERVICE

- A. **Initial Maintenance Service:** Beginning at Substantial Completion, provide two years full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. See Appendix I.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. All acceptable manufacturers are indicated in the individual equipment sections.

2.02 MATERIALS, GENERAL

- A. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.
- B. Steel:
 - 1. Shapes and bars: Carbon.
 - 2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
 - 3. Finish: Factory-applied baked enamel.
- C. Stainless steel:
 - 1. Shapes and bars: No. 4 brushed or No. 8 polished stainless steel.
 - 2. Tubing: No. 4 brushed or No. 8 polished stainless steel.
- D. Aluminum:
 - 1. Extrusions: Alloy 6063
- E. Glass: Clear laminated safety glass, complying with ANSI Z97.1, nominal 9/16" thickness.

2.03 HOISTWAY EQUIPMENT

- A. Cab Platform
 - 1. Replace existing platform with new metal platform. Finish and paint all metal components with rust-proof paint.
 - 2. Replace fireproofing. Replace damaged sub floor to create a solid substrate for finished flooring material specified elsewhere. Provide new safety plate fixture and cover to match cab saddle. Check for loose welds and repair. Prevent movement of metal flooring.
- B. Cab Sling

The cab sling shall be new. All bolts on the safety plank, stiles and crosshead will be secured. Bolster with bracing members to remove strain from the car enclosure. New sling shall be as high as clearances allow.
- C. Guide Rails

Verify condition and sizing and reuse car and counterweight guide rails if acceptable. Provide all work necessary for smooth operation of the car and counterweight guides. Reinforce with steel brackets, tighten fishplates, guide clips and hardware and align rails. File the rails, remove rough edges and clean all surfaces. Ensure that required plumbness is maintained ($\pm 1/8''$). Provide adequate clearances for building compression.
- D. Guides
 - 1. ELSCO
 - 2. An approved equal

Provide roller guides, with a minimum of three tires six (6) inch roller type guide on the cab sling and three (3) inch roller guide on the counterweight slings), shall be mounted on top and bottom of the car and counterweight frame and be held in contact with the guide rail by adjustable devices. Bolt guide rails to the car frame at top and bottom of the slings. The guide roller shall be designed to operate on non lubricated guide rails.

E. Buffers

Provide new spring buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

F. Counterweights

Reuse counterweight and modify weights to achieve code related counterbalance. Heavier, more compact plates can be used as additional weights. The counterweight must contain the cab weight plus a percentage of the capacity (approximately 40% for traction machines). All required modifications to the counterweight must be included in price. All elevators must be completely balanced. New counterweight guards and signage shall be furnished.

G. Hoistway and Pit Lighting & Receptacles

Provide all new compact floor fixtures with guards and clear from the elevator travel path. Provide ground fault indicator (GFI) receptacles in the elevator pit, on top of elevator cab, overheads, secondary space, etc. Provide two (2) GFIs on the car top for the security system and future camera installation.

H. Emergency Terminal Limits

Place electric limit switches in the hoistway near the terminal landings. Limit switches shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing. Provide slowdown limits, normal limits and final limit switches as per code.

I. Automatic Self-Leveling

Provide each elevator car with a self-leveling device featured to automatically bring the car to the floor landings (+/- ¼ ") and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic, accurate and independent of the operating device, provided that there is no interruption of power to the elevator. The car shall be maintained approximately level with the landing irrespective of its load or rope slippage. A pre-defined code compliant range should be arranged to safely move passengers.

J. Traveling Cables

Provide new traveling cables, properly suspended by code approved Grips or steel cores and anchored as per manufacturer recommendations. The conduit must be fire resistant and the cables shall have a proper size loop and be free from contact with the hoistway construction, car, counterweight and other equipment. For lighting circuits use 12AWG copper. All other wiring shall be 24AWG copper. All traveling cables shall contain 10% spare wires (no less than two spare wires for each type). The traveling cables shall have steel-supports and shall be run directly to the machine room, hung at the top of the hoistway at a distance of 6 feet from top of hoistway overhead. Traveling cable will be properly enclosed at the top hoistway and under the car with its steel core. Use a universal hanging system where applicable, (>200 feet). For hanging lengths of less than 200 feet, use rated grips sized for each traveler. Utilize manufacturer's installation procedure.

K. Cab Camera / Communications Wiring

Provisions shall be included for wiring for voice communication, music, cameras and monitors. Minimum Requirement (add 10% spares). The run will be from the cab bottom to the machine room and any other areas designated on any drawings or other specifications as part of this modernization, installed in separate junction boxes in all locations. The

- Two (2) pairs of Type A cables
- Two (2) (CCTV) coaxial cables, R659
- Two (2) sets of twisted shielded 20 gage cables for security system.
- Two (2) sets of twisted shielded 20 gage cables for security camera.
- All switches and related equipment.

Provide switches for safe operation & maintenance of the elevator, mounted in the hoistway, pit, overhead sheave rooms, secondary spaces and machine room as well as on the elevator cab sling and enclosure shall be replaced or added new as required for the new installation and Code requirements. All stop switches must be the push/pull design.

L. Limit Switches

Provide limit switches which shall be silent when activated. All switches should be adjustable for future stopping modifications which shall conform to ANSI CODE requirements. Existing switches shall be removed. Rollers, if used, shall be equipped with engaging cams and provided with soft resilient type rollers for quiet operation. Provide terminal slow-down switches and wiring. Switches should be set to allow for a smooth stop. The normal limit switch shall be designed to bring the elevator automatically to a stop at the top and bottom terminal landings with any load up to and including 125% of the contract capacity and speed attained in normal operation. Final terminal stopping devices shall be designed to stop the car and counterweight automatically, independent of all other operating devices, but with the buffers operative. When the final terminal stopping devices operate normal operation in either direction shall be prevented. In cases where the limit cam will obstruct the pit ladder, they will be re-located to the other side of the elevator

- M. Provide whisperflex compensating cables as per code with proper grips and guides in the pit. Provide switch on the underside of the bottom of the car that will remove power to the elevator in case the cable becomes loose or gets disconnected.**

2.04 MACHINE ROOM EQUIPMENT

Equipment that will be located in machine rooms and/or secondary shall include; Main Machine, Motor, Brake, Sheaves & Wire Ropes, Rope Gripper, Controller, Dispatcher, Selector, Control Equipment (Drives, Motor Generators) Governors and Mainline Switches.

Machine Beams: Review adequacy of support beams, angles, plates, bearing plates, blocking steel members and all structured members. Any alterations required to properly support machine, governors, deflector and overhead sheaves shall be provided. Provide additional anchor bolts, templates and support beams for machine as required. Provide and related support steel. All bearings, steel, plates, mounting steel modifications and sheaves shall be included in the installation of the machine.

A. Isolation

Provide proper isolation for all mechanical and electrical equipment and any structural components, to prevent vibration, harmonic distortion, mechanical and electrical noise, audible noise and radio frequency interference to within acceptable limits of applicable code(s).

B. Labeling

Identify machine room components by number, as required by applicable codes and local regulations. All elevators, which have a designated device number by the Elevator Division of the Department of

Buildings, must have a metal tag on all machine room equipment. This tag shall be in block type with a minimum of 1/4" height and securely attached in a permanent manner to the driving machine, controller, motor generator set or drive unit and the disconnecting means.

In addition, each elevator component shall be painted with the designated elevator letter. Each letter shall be four (4) inches in height and shall be located in a manner that recognition can be made from any area within the machine room.

C. Disconnect Switch(es) – Main Line

The main machine shall be visible from the main line switch. The main line switch shall conform to all codes and authorities having jurisdiction. The main line will have sufficient amperage to provide for all elevator equipment without overloading any piece of equipment. The main line disconnect will have proper breakers and shall be lockable in the open position. Contractor is to verify all power characteristics for proper sizing of the equipment.

D. Lighting – Machine Room

The contractor will provide new fixtures that will provide adequate illumination intensity for safe movement and to perform needed work on machine room equipment as shown on drawings. A switch shall be installed and located next to the machine room entrance which will control the lights. Light fixtures shall be installed above each piece of equipment such as machine, controller, governor and mainline switch panel to achieve properly distributed illumination for all equipment.

The contractor will provide an auxiliary disconnect as per code for cab lighting.

E. Electrical

Contractor shall review and test as necessary to verify the general compliance and sufficiency of electrical service and conformity with applicable codes. Breakers (Fusing) must be code compliant. Existing grounding, feeding service and distribution in the elevator machine room shall be reviewed and upgraded as per code and equipment requirements. Although the electric power supply details are provided elsewhere in these specifications, it is the responsibility of the elevator contractor to take all readings and measurements with proper instruments to determine actual electric loads of existing equipment. This information will be utilized to design and size the proposed new equipment by the contractor based upon actual current and voltages to prevent electrical tripping and elevator shutdowns with new equipment.

F. Load Test

Prior to commencement of cab work a balanced load test must be performed on the elevator. If multiple elevators are present, a typical elevator per bank shall be selected. The results of this test shall be included with submittals and should include the individual weights of the cab & counterweight prior to modernization. The results shall also include calculations of car and counterweight loads and how the code required percentage of rated capacity is achieved. The Contractor shall include the cost associated with replacing the counterweight frame in their bid as a separate item if required.

Counterweight modifications that make the existing frame unusable, non code complaint or cause building reactions to change more than 5% shall be brought to the attention of the Architect.

G. Main Machine

1. Hollister Whitney
2. Imperial
3. An approved Equal

Furnish and install new gearless traction hoist machines. The hoisting machine shall be a gearless traction type, consisting of new AC motor, new brake, gear assembly in a gearbox and new driving

sheave mounted in alignment on a new rigid, common bedplate. A large diameter, forged shaft shall serve as a support for the motor armature and for the removable drive sheave and brake drum/disc. It shall be supported by roller bearings. Steel deflector sheaves of adequate diameter and strength shall be provided. All bearings shall be included and shall be ball bearing type. The grease fittings shall be easily accessible. All cables and guards shall be provided as per Code.

The drive sheave will be cast from high metal grade. (Brinell hardness: 215 to 230). Accurate machining will be done to provide grooves of proper depth and shape. Ensure maximum traction with a minimum of cable and sheave wear. Ball bearings shall be provided.

The Machine shall be mounted in a machine room directly over the elevator on structural steel beams or channels and bearing plates furnished by the elevator installer. Beams shall be securely fastened to the supports supplied by other trades.

H. Drive System

Provide a new solid-state drive system as follows:

1. The drive system shall be of the non-regenerative Variable Frequency type.
2. The system shall be a vector controlled pulse-width modulated AC drive. The variable voltage variable frequency drive shall convert the AC power supply using a two step process to a variable voltage variable frequency power supply for use by the hoist motor.
3. The speed control shall be by means of vector control providing independent excitation and torque current. A digital absolute velocity encoder shall be provided giving feedback to the controller on armature position and motor speed.
4. Provide suitable chokes/filters to keep harmonics (electrical and acoustic) to within limits for residential buildings mandated by NEC/IEEE and OSHA.

I. Motor

The motor shall be designed for use with the elevator and have class "F" insulation. The motor armature shall be dynamically balanced and supported by roller bearings of ample capacity. The armature and driving sheave shall be properly balanced for smooth, high-speed elevator performance. The motor will be fully reversible, have low starting torque and starting current. The motor shall be rated in accordance with the standards of the AIEE. The motor must be of 30 horse power and designed to have the capacity to operate the elevator at rated contract load and speed without overheating. During operation with the controller, the rated speed shall remain constant plus or minus 5% under all loads in the specified range. The motor shall be designed, balanced & aligned with the brake pulley to prevent vibration.

J. Brake

The brake shall be a spring applied electric brake; held open by an electro-magnet actuated by a digital brake controller and designed to work as an integral part of the motor controller to provide smooth positive stops. The Brake shall be designed to automatically apply in the event of interruption of power supply from any cause. Operation and control of the brake shall be all digital. The setting and lifting of the brake shall be software based and all electronic. All adjustments and setup of the brake shall be made using a PC interface. No contactors or resistors shall be use in the actuation of the brake. A new electromechanical disc brake shall be provided on the machines. The new brake shall be spring applied and electrically activated. Brake shoes shall be applied to the braking areas simultaneously and with even pressure by means of helical compression springs. An electro magnet shall be used for fast release and for gradual smooth operation of shoes. The brake shall be able to hold 125% of the elevator capacity. The contractor shall provide all necessary machine supports and anchoring. Brake switches are required to monitor brake activation.

K. Ropes:

1. Bethlehem Steel
2. An approved Equal

Properly designed steel hoist ropes of size and number to ensure proper wear qualities shall be used. Cables designed for elevator use with ANSI Code mandated safety ratings for the elevator speed and capacity must be used. Wedge shackles and springs designed for use with steel ropes shall be used for securing purposes as per code. Anti-spin devices shall be used. (1/8" stiff cable shall be used and secured with two (2) Crosby Clips on both the car and counterweight. New hitch plates on the car and counterweight sling shall also be provided by the elevator contractor. Hoist rope data shall be marked on the crosshead data plate and rope tag. Furnish adequate compensation for weight of hoist ropes when required to maintain proper counterbalance ratio.

Governor rope shall be 3/8" iron.

L. Emergency Brake

1. GAL/Hollister Whitney
2. An approved Equal

Provide an emergency brake to grab elevator suspension ropes to stop the elevator in the event of a mechanical or electrical failure. If an ascending elevator overspeeds in the up direction and also if the elevator leaves the floor with the doors opened this device will be activated.

M. Safety and Governor

1. GAL/Hollister Whitney
2. Approved Equal

All safety devices shall be replaced with new. All safeties shall be completely tested before any elevator is restored to service. All missing or worn parts/hardware shall be replaced. Car safety shall be mounted on the bottom members of the car frame and be operated by a centrifugal speed governor and tension sheave assembly. Governor rope shall be 3/8" iron. The governor shall be designed to cut off power to the motor and apply the brake whenever the governor indicates the car has excessive speed. The governor shall function when the car over speeds in either the up or down direction. The governor will be mounted above the car. The proper tension in the governor rope shall be maintained by the weighted tension sheave located in the pit. The governor shall be equipped with rope grip jaws designed to clamp the governor rope so as to actuate the car safety upon a predetermined overspeed in either direction. Overspeed setting >115% of specified rated car speed and < the maximum governor tripping speed specified in the applicable elevator Code for the specified rated car speed. When operated, no undue damage to the governor rope shall result from the stopping action. Adjust the governor and mark the tripping speed specified on the tag.

2.05 HOISTWAY ENTRANCES**A. Doors and Frames**

All existing shaftway door entrances/frames and doors shall be reused. Stops, pockets, sight guards and appurtenances at all floors on all panels shall be provided. Fascias and dust covers shall be installed on all floors. Hatchway door sight guards shall be secured on all doors as needed. All entrance panels and frames shall be thoroughly cleaned. All unused key access holes shall be plugged & sealed. Kick blocks on entrance saddles and "Z" brackets shall be installed on all hatchway door panels (8"). New gibs and brackets shall be provided at the bottom of each door and engage the sill at least 1/4 of an inch as required by Code. Doors shall include service or emergency key ways to meet all code requirements. All door jambs shall have the correct door jamb markings located on both sides of the door jamb. Provide new accessories as needed.

B. Interlocks

Equip each hoistway entrance with new approved type interlock, tested as required by code. Interlock shall be designed to prevent the opening the doors at any landing from the corridor side unless the car is at rest at that landing or is in the leveling zone and stopping at that landing. The operation of the elevator driving machine shall be prevented by means of opening the safety circuit, unless the shaftway door is locked in the closed position, except when the car is in the landing zone and is either stopped or being stopped. Interlocks shall be so located that they are not accessible from the landing side of the shaftway doors. Hoistway door unlocking devices shall be provided and be of the type specified by the governing code. All hoistway interlocks, contacts and unlocking devices shall have met all applicable functional and engineering tests required by the applicable elevator Code and all such equipment shall have been certified by a competent approved laboratory.

C. Door Hanger and Tracks, Sheaves, Closers, Rollers, Fascias, Astragals, Door Bumpers, Guards, Gibs, Dust Covers, Sight Guards, Jamb Markings, etc.-Remove and replace with new.

Provide new hoistway door equipment and accessories on all doors. Damaged stainless steel sills will be replaced with new with proper supports. New vision glass guards permanently attached to each hatchway door will be installed. All cab and hatchway door Astragals shall be replaced.

D. Hoistway Sills

Clean and Retain. Damaged sills will be replaced. Note number of sills included in bid. If no sills are noted in the bid, it will be assumed that all hoistway sills are being replaced.

2.06 PASSENGER ELEVATOR CAR ENCLOSURE**A. Cab Dimensions: 43”X56”X88”H- 36” 2 Speed Doors, 84” H****B. Increase height of the cab by 12 inches or maximum available while meeting code required clearances.****C. Car Enclosure - General**

1. Based upon Preliminary Balance Load Test results the contractor shall determine the maximum cab weight that can be installed without requiring a new counterweight frame, without exceeding the load rating of the equipment, or without violating requirements of the Code.
2. Reinstall all equipment that is being retained. Provide and connect new elevator equipment being installed in the cab.
3. It is the responsibility of the Contractor to insure that all alterations shall not increase the original building design reactions by more than 5%.
4. Conduct final balanced load test when all work has been completed.
5. Contractor shall statically balance the cab after refurbishment is completed.
6. All coordination.
7. Related work not specifically mentioned above to ensure a complete cab installation.

D. Cab Enclosure

1. Provide a cab based upon information specified herein to ensure timely communication and completion. If necessary, visit the County/Architect along with samples, designs and renderings based upon allowance to facilitate cab selection.
2. Hanging cab wall pads: One (1) set per elevator durable and padded with durable masonite. The pads shall be designed to protect the cab interior during equipment moves. All accessories required for building personnel to hang pads must be included in each set.
3. Lighting: As indicated on drawings.

4. Cab Door: Provide new cab door panel constructed in rigid steel or aluminum. Panel shall be 14 gauge furniture steel or aluminum. All bolt hole patterns shall be pre-drilled and tapped. Provide "Z" brackets, Code mandated gibs & kick blocks.
 5. Ventilation, Entrance Columns, Frieze Panels, base wainscoting, transoms & other design details.
 6. Finish selection. Cab walls shall be of Stainless Steel #4 finish. 1/8" stainless steel diamond plate panels will be fastened to all the walls. Each wall will have two section vertically separated. These plates shall be properly secured in a manner that can be easily removed for future replacement. Cab flooring shall be 1/4" Stainless Steel Diamondplate.
- E. Contractor shall include all work and cab-related equipment specified elsewhere in this specification, as well as the following:
1. Permits, tests, fees, and all other costs required by the authorities having jurisdiction to complete the installation according to Code.
 2. Flooring, Sub-Flooring, Sill (Saddle).
 3. Car Door Hangers
 4. Switches, Emergency Exit Switches.
- F. Cab Saddle
The elevator contractor shall install new nickel silver cab saddles or as per drawings..
- G. Car Top Inspection
Provide a car top inspection station with an "Emergency Stop" and Inspection/Automatic switch and constant pressure "safe", "up" and "down" direction buttons. The Inspection switch shall make the normal operating devices inoperative (including Fire Recall) when in the Inspection position and give the operator complete control of the elevator. Mount the car top inspection station to the cab crosshead or make it portable with a permanent and safe electrical cord. A minimum of two (2) lights, with an on/off switch and guard with proper brightness, fire buzzer and light inspection switches.
- H. Emergency Exits
The cab shall have an emergency exit on the top of the cab enclosure as per code. Mechanical locks shall be provided so that elevator passengers cannot exit without assistance. Provide fastening mechanism to anchor the hatch to the top of cab.
- I. Signage
All elevator cabs shall be equipped with all code required signage. The following signs shall be engraved directly on to the cab pushbutton panels.
ID#, Capacity, No Smoking, Inspection Certificate Location, Direction for Fireman's Recall, Direction for Operating Communication System, Signage required by County or current code.

2.07 DOOR OPERATION

A. Door Operator

Provide a direct or alternating current motor driven heavy duty solid state double closed loop operator designed to operate the car and hoistway doors simultaneously smoothly without a slam in both directions. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. In event of power failure, the mechanical door operating mechanism shall be arranged for instantaneous manual operation of car door and the hoistway

door The hoistway door shall continue during emergency operation to be self-locking and self-closing. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. The door shall be designed to operate at an average opening speed for 2 feet per second. This closing door speed must be adjustable keep the Kinetic Energy striking force to within industry standards. Provide rubber bumpers at both ends. Interlocks and safety contacts shall be provided.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel will reverse and the door will reopen to answer the other call.
4. Nudging Operation (Must have on/off capability. Keep normally off & turn on at County's request). The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.
5. Limited Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Car Door Operator Accessories

Provide new car door hanger track assemblies and header which shall be of the heavy duty type. All door accessories shall be approved. Two, two-point suspension sheave hanger roller assemblies, with related operating linkages, gate switch, clutch, zone lock and accessories shall conform to the applicable elevator Code requirements.

C. Door Protection Device:

1. Tritronic
2. An approved Equal

Provide a waterproof door protection system using 150 or more microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen. The device shall be designed and adjusted to minimize the possibility of injury to passengers and shall not project into hoistway door opening. A mechanical reopening device shall not be acceptable.

2.08 CAR OPERATING STATION

The car station buttons shall become individually illuminated with L.E.D. type bulbs as a button for the desired floor is pressed. These lights shall be extinguished as the call is answered, or the demand is satisfied.

The alarm button with acknowledgement light and red emergency stop switch shall be located 35 inches from the floor, and control buttons not more than 54 inches from the floor. Activation of the stop switch shall not cancel the registered car or corridor calls, and after the switch is released, the car shall continue to answer its registered. The entire system shall comply with all authorities having jurisdiction.

- A. Car Operating Station: The main car control in each car shall contain the devices required for specific operation. An inspection switch to make normal operation inoperative and allow use of the top-of-car operating station shall be provided. All switches not normally used shall be located behind a locked hinged panel. The following switches will also be provided; light, inspection, emergency light test, as well as a 110 A.C. outlet, 2-speed fan, attendant switch, up, down, and pass buttons, as well as all firemen's recall devices.

The panel shall consist of the following pushbuttons, key switches and indicators:

1. The bottom of the Car Operating Station shall contain a functional "door open," "door close," "alarm" buttons and a keyed "emergency stop" switch.
2. The Intermediate area of the station shall contain floor buttons which illuminate when a call is registered and remain illuminated until the call is answered. Raised floor indications and handicap symbols shall be located to the left and immediately adjacent to the floor buttons. No applied symbols or floor indications or symbols on the buttons shall be permitted.
3. The next level shall contain supplied options switches.
4. The top of the Car Operating Station shall contain fire service features, including operating instructions, in accordance with ASME A17.1 and local code.

A sounding button shall also be included on each cab panel to allow handicap persons the options of sounding an audible signal when passing each floor. Contractor must include all costs to modify cab wall to accommodate the new position of car station if existing cabs are being retained. The communication system will be provided with visual acknowledgements for the deaf.

- B. Position Indicator: A position indicator shall be contained above floor push buttons. As the car travels, its position in the hoistway shall be indicated by the illumination of the alpha/numeric character corresponding to the landing which the elevator is stopped at or passing.
- C. Column Mounted Car Traveling Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound and illuminate when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close. The direction arrows shall be equipped with chimes, to indicate the direction that the car is traveling. An adjustable electronic chime shall be incorporated in the fixtures to sound as it is illuminated to call the attention of the waiting passengers. The arrows and electronic adjustable tone devices shall comply with applicable elevator Code requirements.

- D. **Emergency Light:** Self-powered emergency light with an extra long life power-pack (rechargeable battery and automatic charger). The emergency light system may be incorporated into the cab pushbutton panel or as an alternate the emergency lighting system shall be designed to keep some ceiling lights on. The panel emergency light shall consist of white LED's and be capable of putting out a minimum of four (4) foot candles, one foot out and four foot in front of the car swing panel. The emergency light will illuminate automatically upon loss of the building's normal power supply. The system shall operate automatically when power failure is sensed. Any relocation or design change of this panel shall be included by the elevator contractor.
- E. **Communications:**
Ring Communications
An Approved Equal
 Provide an emergency communications device mounted integrally within the car station which shall include be a speaker in the cab pushbutton panel and an auto-dialer system. A two-way communications means between the car and a location in the building that is readily accessible to authorized and emergency personnel shall be provided. Means shall be provided to enable two-way voice communication between the machine room and the interior of the car. Location and type of system will be as per industry standards and subject to approval. The system shall be completely wired including all wiring, conduits electric, fittings, etc. Prior to modernization, the County retains the right to relocate the communication system.
 The following will be furnished and installed: RMS 5000 EX with battery backup, Wall mounted unit, Two (2) AA916s for the machine room and security station for desk, AA 916 master station, and Car station mounted unit SS900B and AN 913 and Dialer DNA 934P. Telephone line will be connected to RMS 5000RX.
- F. Include the following special controls:
1. Independent service switch.
 2. Inspection switch.
 3. Two speed fan/light switch.
 4. Certificate frame.

2.09 CONTROL SYSTEMS

1. Motion Control Engineering
 2. GAL
 3. ESI
 4. Swift
 5. An approved Equal
- A. **Controller:** The elevator control system shall be microprocessor based and software oriented. The system shall operate in real time, continuously analyzing the car(s) changing position, condition, and work load. All controller and operational circuits including the brake control and drive system shall be digital. Control of the elevator shall be automatic in operation by means of push buttons in the car operating panel numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings
1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
 2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is

at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.

3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
4. A car that is stopping for the last hall call in the preference direction and that hall call is for the opposite direction with no onward car calls, shall reverse preference when the selector position advances to the landing at which the car is committed to stop. A car that is stopping for the last hall call in the preference direction, and that hall call is for the same direction, shall hold its preference until the door is almost closed allowing time for a passenger to register an onward car call which will maintain the preference. If no car call is registered before the door is almost closed, the car will lose its preference and shall be available to accept calls in either direction.]

B. Operation:

Duplex Operation-Opposite elevators: Where group operation is required, the group supervisory operation shall be embedded within selected car controllers. No separate group controller shall be supplied. The microprocessor shall constantly scan the system for hall calls. When hall calls are registered, the control system shall immediately calculate the estimated time of arrival using such information as, number of floors to travel from the current position, the time it takes to travel one floor at top speed, calls assigned to a car, and car reversal time to respond to a call in the opposite direction of travel. When a car's status changes or additional hall calls are registered, the estimated time of arrival shall be recalculated and calls reassigned if necessary.

1. Traffic Pattern: The microprocessor shall provide flexibility to meet well defined patterns of traffic, including up peak, down peak, and heavy interfloor demands, and adjust for indeterminate variations in these patterns which occur in buildings.

C. Load Weighing Device: Provide a load weighing device on each car which, when the particular car is filled to an adjustable percentage of the capacity load, shall cause the car to bypass landing calls but not car calls. The passed landing calls shall remain registered for the next following car.

1. The device shall be unaffected by the action of compensating chain or rope. The device shall detect a 15 pound (7 Kg.) load change under all conditions.
2. The load sensor shall use a linear variable differential transformer to accurately measure the weight in the car. The information shall be transferred via a serial link to the elevator controller.

D. Anti-Nuisance Call Control: The microprocessor control system shall evaluate the number of people on the car and compare that value to the number of car calls registered. If the number of car calls exceeds the number of people by a field programmable value, the car calls shall be canceled after the first call has been answered.

E. Position Selector: The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slow down points in memory.

F. Motion Control: The drive control system shall be dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit continuous comparison of

machine speed to velocity profile and to actual car speed. This accurate position/velocity feedback shall permit a fast and accurate control of acceleration and retardation.'

- G. Motor Pre-Torque: Current shall be applied to the elevator drive before the brake is released and the speed pattern is dictated to eliminate roll back and sling shot effects of unbalanced loads in the car. The electronic load weighing system shall determine the load on the car which will be used in determining a pre-torque reference to send to the drive.
- H. Emergency Power Operation: Upon loss of normal power, building-supplied standby power is available to the elevator on the same wires as the normal power.. Once the loss of normal power has been detected and standby power is available, one elevator at a time from each group will be lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed and the car shuts down. The next available car in the group will then be selected to lower, allow passengers to exit, close the doors and shutdown. This process is repeated until all cars in the group have been lowered and parked. At this time, an elevator is automatically allowed to continue service using the building-supplied standby power. A manual selection switch is available to override the automatic selection and allow and car in the group to provide service to the building. When normal power is restored, the elevators automatically resume operation.

2.09 HALL STATIONS

- A. Hall Stations: Provide ADA compliant, "top of the line" buttons (subject to County approval) with red-illuminating LED halos to indicate that a call has been registered at that floor for the indicated direction. Provide engraving on hall buttons. Each terminal station shall contain one illuminating push button. Those lights shall operate individually to indicate that a call has been registered. The lights shall extinguish as the calls are answered.
 1. Each intermediate station shall consist of two illuminating pushbuttons, one for the up direction and one for the down position.
 2. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

Existing hall buttons if located in the door frame shall be relocated and existing boxes patched with steel plates filled, sanded, and made smooth for painting. Provide a new cutout in adjacent wall to accommodate the new hall button box and plate.

- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements and, when required by local code: Section 407 in ICC A117.1.
- C. Hall Position Indicator: Provide illuminating LED indicators on each floor.

2.10 HOISTWAY PIT

- A. Pit Ladders
Provide pit ladders in accordance with Code.
- B. Locate the ladder so as not to obstruct elevator operation.
- C. Pit Drain

Existing drain will be used.

2.11 Electrical Wiring

Provide new wiring as per 2011 edition of National Electrical Code. Replace all rusted conduit, boxes and flexible raceway must be replaced new. Terminal connections for all conductors at equipment panels, center of hoistway terminal blocks or studs shall have identifying numbers. Provide all wiring from the controller, selector, dispatching panels. Wiring shall be properly insulated and have flame-retarding and moisture-resisting outer cover and shall be run in galvanized metallic conduit or duct, using strain boxes as required. Each device will have a ground stud with grounding returning back to the controller.

Provide lighting in pit as per code.

2.12 Venting

Machine Room: Elevator machine rooms that contain solid-state equipment for elevator operation shall be provided with independent ventilation or air-conditioning system to protect against the overheating of the electrical equipment. The system shall be thermostatically controlled and capable of maintaining temperatures within the range established for the elevator equipment which will be stipulated by the selected manufacturer. (Typically 20,000 Btu).

Hoistway: Provide venting of the hoistway to the outside to meet applicable code requirements. The vent area shall be 3 ½ % of the cross sectional area of the elevator hoistway but not less than 3 square feet. The existing vent holes in the machine room shall be ducted to the outside by provide openings in the machine room wall that shall be properly anchored with lintels. Dampers shall be provided on the vent opening that will be activated by a smoke detector installed at the top of the hoistway. Provide louvers and bird/rodent screen on the outside of the controlled by a thermostat and dampers as indicated on the drawings. Provide adequate fireproofing and grouting to cover all unused openings.

2.13 Emergency or Standby Power: This elevator shall be capable of operating on emergency power supplied by the building in the event of a power failure as per building code requirements. The emergency power system shall be capable of operating the elevator with rated load, at least one at a time. The transfer between the normal and the emergency or standby power system shall be automatic.

An illuminated signal marked "ELEVATOR EMERGENCY POWER" shall be provided in the elevator lobby at the designated level to indicate that the normal power supply has failed and the emergency or standby power is in effect.

Firefighters' Emergency Operation shall apply to all automatic elevators as per code.

2.13 Provide emergency battery device to safely move the elevator to the next landing and open the doors.

2.14 Provide any other switch/component required by current code.

PART 3 - EXECUTION

3.1 EXAMINATION & DEMOLITION

- A. All existing equipment that is listed in Part 2 as being replaced as part of this modernization must be properly removed and disposed of in strict accordance with all codes.
- B. Before starting elevator installation, inspect hoistway, hoistway openings, pits and machine rooms, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions

under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

- C. Commencement of installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 INSTALLATION

- A. Install elevator systems components:
 - 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 - 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. Schedule work in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- F. Phasing of all work shall be coordinated with County Construction Coordinator prior to commencing any work. All necessary permissions shall be obtained prior to commencement of work.
- G. Unless authorized in writing otherwise, all work shall be done on Monday through Friday only, 7:30AM to 4:00 PM, excluding holidays.
- H. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.
- I. Sound isolation: Mount rotating and vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent the transmission of vibrations to the structure, and eliminate sources of structure-borne noise from the elevator system.
- J. Alignment: Coordinate modification of hoistway entrances and elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- K. Lubricate operating parts of system, including ropes, as recommended by the manufacturer.
- L. Remove all old unused pipes wires and ducts and patch any damage caused by removal.
- M. Patch holes in hoistway.

- N. Bevel all ledges in hoistway as per code.
- O. Lubricate operating parts of system, including ropes, as recommended by the manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.
- B. Advise County, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.4 ADJUSTING

Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.5 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; shall not be cleaned with bleach-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

3.6 PROTECTION

At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.7 DEMONSTRATION

- A. Instruct County's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train County's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with County's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.8 Fireman Recall Key Switches & Operation

Fireman Recall buttons and key switches that will function in conjunction with the Fireman's Recall System will be provided in the Car Station and Lobby Hall Station. This will meet the latest New York State & City of New York Fire Codes and any code changes that occur during modernization shall be retroactive .

Emergency Fire Operation shall be designed to meet current code for Phase I & II operation. Emergency Operation shall equip the elevator with a control system to operate under, and/or recall the cars in fire or other emergency condition. All the features shall meet with the governing Firemen's Recall codes and Local Building codes. Emergency return to the lobby shall also be initiated with the Fire Emergency Procedures.

3.9 Independent Service

Provide independent service by providing the operating panel with a key operated switch. This key shall permit the car to by-pass all corridor calls and permit dispatching of the car directly to any floor by pressing the corresponding car button, when closed. The door shall not close until a car button is pressed or until the key operated switch is opened. Normal service shall resume, when key switched is opened.

3.10 Handicapped Requirements

- A. The American Disabilities Act (ADA), NYC Handicapped Code and other applicable requirements shall be complied with on all aspects of the Elevator Modernization.
- B. Alarm bell button and elevator emergency stop switch > 35 inches from floor level, and < 54 inches from the floor level.
- C. Braille markings shall be provided adjacent to the floor and control buttons on the car station panel. They shall be contrasting color background to the left of each button.
- D. All letters and numbers shall be a minimum of 5/8" and raised .03".
- E. The centerline of the hall pushbutton station shall be 42" above the floor when mounting boxes are replaced.
- F. The elevator directional lanterns illuminate their respective directions and sound once for the "up" direction and twice for the "down" direction. The elevator shall have an audible signal to tell passengers that the car is stopping or passing a floor served by the elevator.
- G. On each floor landing, "Designations Signs" shall be placed on all entrances on both sides of jamb at a height of 60" above the floor.
- H. Designations Signs shall be 2" high, raised .03".
- I. An outside communication system shall be provided and installed by the contractor if the building does not have 24-hour building attendant.

APPENDIX I

GENERAL INFORMATION:

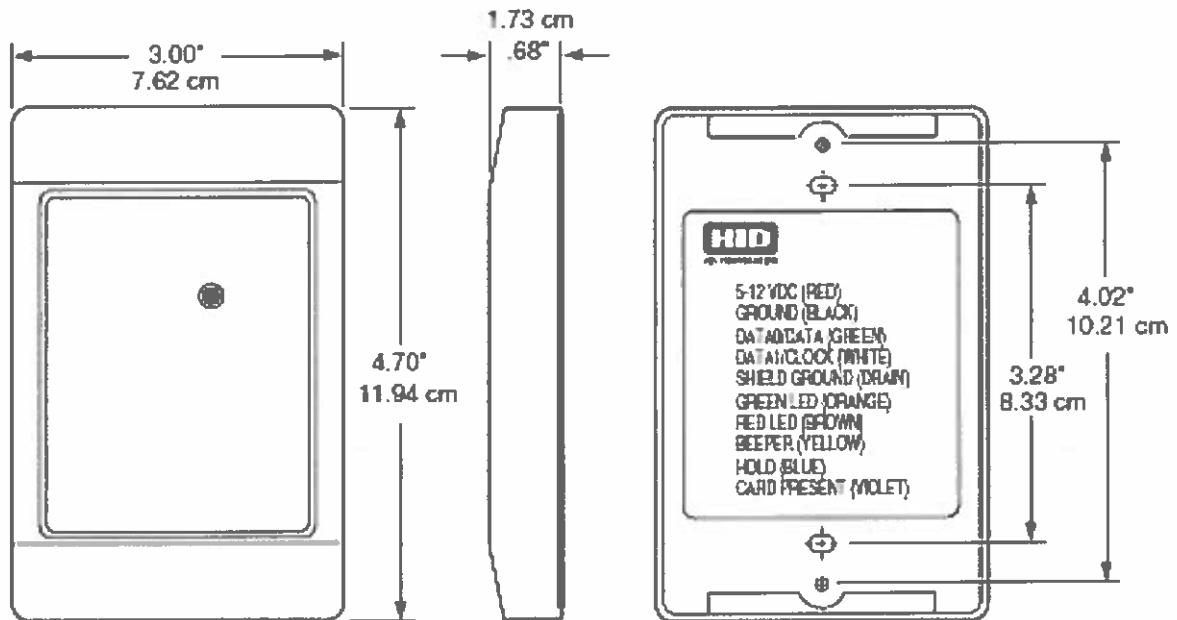
Elevator #	ID#	Classification	Rated Speed (Feet Per Minute) FPM	Capacity (lbs)	Machine Type	Floors Served
111 DR. MARTIN LUTHER KING BOULEVARD. WHITE PLAINS, NY						
3185p	Judges Car -3185P	Passenger	200	1200	Gearless Overhead	B2,B,G,2-19

EQUIPMENT LOCATION:

Elevator #	Machine Room	Secondary	Rail Contact	Pit	Buffer Type	Compensation Means
111 DR. MARTIN LUTHER KING BOULEVARD. WHITE PLAINS, NY						
3185P	Roof	N/A	Roller Guides	Standard	Spring	N/A

MECHANICAL, ELECTRICAL, & DATA TAG INFORMATION

111 DR. MARTIN LUTHER KING BOULEVARD. WHITE PLAINS, NY	
Elevator ID: Freight Elevator	
<u>Main Line Amperage:</u>	100 Amps
<u>Fire Extinguisher Details</u>	Current
<u>HVAC</u>	Venting not per current code Separate Heater and Split System Air Conditioner in Machine Room.
<u>Smoke Detector</u>	Machine Room
<u>Pit Sump Pump</u>	Yes (appears to be non-functional)
<u>Emergency Communications</u>	Yes
Machine	
Type:	Gearless Traction
Capacity:	1200 lbs
Speed:	200 FPM
Controller:	
Type:	Variable Voltage
Model:	VV- 459
Volts/ Phase:	208 Volts, 3 Phase
Power	25 HP
Year/Date Installed:	6/10/1992
Motor:	
Type:	X3640
RPM	850
Amperage:	25/18
Voltage:	230
Horse Power:	25HP
Phase:	3
Frequency:	60
Generator:	
Power	25 HP
RPM	1750
Voltage	240V 15 kW
Governor Details	
Tripping Speed:	250 FPM
Cable Size:	3/8"
Test Data	Five Year -2-2018

APPENDIX II**SECURITY CARD READER SYSTEM****ELEVATOR CONTRACTOR SCOPE OF WORK FOR CARD READER SYSTEM:**

- Provide additional wiring in traveling cables – see Specification Sections 2.03 K and 2.03L
- Cutouts and back boxes in hall call stations to incorporate above card reader dimensions.
- Cutouts and back boxes in car station to incorporate above card reader dimensions.
- Provide relay in machine room/controller for 12/24VDC for relaying interface equipment.
- Install an RM4 box supplied by security contractor on top of car using manufacturer recommended procedures.
- Provide dry contact in machine room.
- Provide additional wiring in separate conduit to each hall station for card reader.

SECTION 142150 – ELEVATOR MODERNIZATION**PART 1 - GENERAL****1.1 SUMMARY**

This Section includes the following:

1. Elevator Modernization Specifications
2. Appendix 1 – Full Service Maintenance Contract

Note: Drawings are provided separately. In the event of any real or apparent conflict in the scope of work, the more stringent conditions shall apply.

1.2 SCHEDULE OF ELEVATORS

See Appendix #1

A. Performance Requirements for Elevators:

1. Quantity & Elevator: One Conventional Holed Hydraulic Elevator
2. Type: Conventional Holed Hydraulic
3. Number of Stops: Three Stops
4. Number of Openings: Four (4) at Front
Front Openings: Floors B, 1,2 & (M)
5. Rise: Existing.
6. Rated Capacity/Speed: 2,500 pounds, 100/125 FPM
7. Minimum Car Inside: Existing
8. Inside Cab Height: 93” to top of ceiling
Height Under Ceiling: 88”
9. Entrance Width & Type: Single-Slide Door: 3’ 6” x or 8’ 0”
10. Main Power Supply: 208 Volts + or - 5% of normal, 3 Phase, with a separate equipment grounding conductor.

11. Lighting Power Supply: 120 Volts, 1 Phase, 15 Amps and 60 Hz.
 12. Stopping Accuracy: $\pm 1/4"$ (6.4 mm) under any loading condition or direction of travel.
 13. Door Opening Time for hoistway and car doors:
3.60 seconds – Single Slide 36" door.
 14. Provide smoke detectors in machine room, all landings and hoistway smoke and heat detectors
- B. Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
- C. Provide microprocessor-based control system with utilizes on-board diagnostics for servicing, trouble-shooting, and adjusting without requiring the use of an outside service tool. If an on-board diagnostic system is not provided, a handheld service tool (or laptop), owner's license, operation manual, and tool instructions must be provided in addition to the control system.
- D. Car Operating Features
1. Simplex Operation.
 2. Two Speed Fan.
 3. On/Off Light Switch.
 4. Solid State Starting
 5. Remote elevator monitoring REM® ready.
 6. Car-Stall Protection.
 7. Firefighters' Service Phase I and Phase II
 8. Top of Car Inspection.
 9. Emergency Communications –Latest Intercom/Auto-Dialer provisions.
 10. Emergency lighting
 11. Door Lock Monitoring

E. Door Control Features:

1. Closed Loop Door Operator is a closed loop, microprocessor based door operator system. The door operator will facilitate smooth operation under varying environmental influences such as, temperature, wind, friction, and component variation. The processor will monitor the door's actual position and velocity compared to its desired position and velocity. If variations are detected in the profile the command will be automatically corrected. The Closed Loop Door Operator control system shall not require machine room door control equipment.
2. Door noise not to exceed 58dBA.
3. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
4. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.

Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.

Primary door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening. Under normal operation and for any door position, the system shall detect as a blockage an opaque object that is equal to or greater than 1.3 inches (33 mm) in diameter when inserted between the car doors at vertical positions from within 1 inch (25 mm) above the sill to 71 inches (1800 mm) above the sill. Under degraded conditions (one or more blocked or failed beams), the primary protection shall detect opaque objects that are equal to or greater than 4" (100 mm) in diameter for the same vertical coverage. If the system performance is degraded to the point that the 4" object cannot be detected, the system shall maintain the doors open or permit closing only under nudging force conditions.

The door reopening device shall also include a secondary, three dimensional, triangular infrared multi-beam array projecting across the door opening and extending into the hoistway door zone. The door opening device will cause the doors to reopen when it detects a person(s) or object(s) entering or exiting the car in the area between the hoistway doors or the entryway area adjacent to the hoistway doors.

The size of the secondary protection zone shall vary as the door positions vary during opening and closing. The width of the zone shall be approximately one-third the size of the separation between the doors (or door and strike plate for single-slide doors) and shall be approximately centered in the door

separation. In order to minimize detection of hallway passers-by who are not entering the elevator, the maximum zone penetration into the entryway shall not exceed 20" for any door separation. Normal penetration depth into the entryway from the car doors shall be ~14" for a door separation of 42". The penetration shall reduce proportionally as the doors close. At door separations of 18" or less the secondary protection system may cease its normal operation since the depth of the zone recedes to where it is inside the hoistway doors. The vertical coverage of the secondary protection shall be ~19" (480 mm) above the sill to ~55" (1400 mm) above the sill (mid-thigh to shoulder of a typical adult).

The secondary protection shall have an anti-nuisance feature which will ignore detection in the secondary zone after continual detection occurs for a significant time period in the secondary zone without corresponding detection in the primary protection zone; i.e. a person/object is in the entryway but does not enter. Normal secondary protection shall be re-enabled whenever detection occurs in the primary zone.

The reaction time of the door detector sub-system shall not exceed 60 milliseconds when both primary and secondary protection capabilities are active; nor 40 milliseconds when the secondary protection is disabled.

5. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

F. Provide equipment according to Seismic zone: 2

1.3 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes and similar information. Submit manufacturer's product data for each system proposed for use. Include the following:
 1. Signal and operating fixtures, operating panels and indicators.
 2. Cab design, dimensions and layout.
 3. Hoistway-door and frame details.
 4. Electrical characteristics and connection requirements.
 5. Expected heat dissipation of elevator equipment in machine room (BTU).
- B. Shop Drawings: Show plans, elevations, sections and large scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Indicate loads imposed on building structure at points of support, and maximum and average power demands.

No general submissions will be made. Details of equipment that is directly proposed for the job shall be submitted. All submissions will be made in binders that must be appropriately formatted. Submit approval layout drawings. Include the following:

1. Car, guide rails, buffers and other components in hoistway.
2. Maximum rail bracket spacing.
3. Maximum loads imposed on guide rails requiring load transfer to building structure.
4. Loads on hoisting beams.
5. Clearances and travel of car.
6. Clear inside hoistway and pit dimensions.
7. Location and sizes of access doors, hoistway entrances and frames.

C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

List of Submittals

- MAIN LINE DISCONNECT
- MACHINE – BRAKE, SHEAVES, WIRE ROPES
- HOIST MOTOR
- CONTROLLER SELECTOR & DISPATCHER -
- OPERATION, CONTROL, AND SIGNAL SYSTEMS.
- MOTOR CONTROL & DRIVE UNIT
- GOVERNOR & TENSION SHEAVE
- PLATFORM, SLING & SAFETY
- ELEVATOR CAR ENCLOSURES & HOISTWAY ENTRANCES.
- DETECTOR EDGE
- “Z” BRACKET
- DOOR OPERATOR, TOP OF CAR INSPECTION STATION, CAB DOOR AND HOISTWAY EQUIPMENT
- LIGHTING FIXTURES
- LIMITS & LIMIT SWITCHES
- SILLS AND SADDLES
- ROLLER GUIDES / SHOES
- EMERGENCY POWER UNIT & ALARM BELL
- BUFFERS
- OTHER MAJOR EQUIPMENT NOT LISTED

List of Initial Project Submittals (at least three (3) sets):

- A separate page listing the manufacturers of proposed equipment for approval with the bid package.

- This list will also include names of all subcontractors, organizations or individuals not directly employed by the contractor that will be involved with the project. Provide description of proposed work.
- Shop drawings:
 - Show equipment arrangement in the machine room, corridor, pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
 - Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
 - Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
 - Indicate electrical power requirements & branch circuit protection device recommendations.
 - Layout drawings indicating the location of all equipment, switches, limits and electrical sources
 - Cab load calculations including differential weights and details of what work needs to be performed to achieve code mandated counterbalance and changes to building reactions.
 - Power requirements for the elevator(s) and individual major equipment. Heat outputs of machine room equipment to size HVAC equipment.
 - Cab and Hallway fixture details, including color swatches and finish samples. Samples must at a minimum, include buttons, tags, jamb markers, cab material, entrance and signal fixture and edging.
 - Wiring diagrams & equipment cut sheets.
 - A detailed schedule to be submitted which must include the following:
 - Equipment lead times after approval.
 - Detailed breakdown of tasks
 - Any Owner items (fire extinguisher, power, main line, communications line, lighting, etc)
 - Cab drawings and details of walls ceiling & flooring. Provide finished cab weight & weight differential.
 - Hoistway entrance details.
 - Technical details of drives, controls, selector, dispatcher and sequence of operation.
 - Prior to commencement, elevator & electrical permits filed with the Department of buildings.

Samples: For Exposed finishes

Manufacturer Certificates: Signed by Elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

Operation and Maintenance data: Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

1.1 QUALITY ASSURANCE

Regulatory Requirements: Comply with ASME A17.1 (latest applicable version) and elevator design requirements for earthquake loads in ASCE 7

CODE VERSIONS OF THE FOLLOWING AUTHORITIES AT THE TIME OF FILING SHALL GOVERN

- ASME -American Society of Mechanical Engineers / ANSI -American National Standards Institute
 - ANSI A17.1 Safety Code for Elevators and Escalators, 2016 with supplements or Latest Applicable Version.
 - ANSI A17.2 Inspectors' Manual for Elevators and Escalators, 2016 with supplements or Latest Applicable Version.
 - ANSI A17.3 Elevator and Escalator Electrical Equipment, 1996 with supplements to 1998 or Latest Applicable Version.
 - ANSI A117.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
- Uniform Building Code and Local Building Codes – Applicable versions in effect at the time of filing.
- White Plains Building Code
- The Local Electrical Code & National Electric Code (NEC) by reference
- Industry Standard Publications by George Strakosch, where applicable.
- National Fire Protection Association (NFPA).
- The National Electrical Code
- Fire Safety of Hoistway Entrances.
- Life Safety Code
- OSHA – Occupational Safety and Hazard Administration
- Americans with Disabilities Act (ADA) Application Guidelines
- Environmental Protection Agency (EPA)
- Building Officials and Code Administrators - Building Code
- IEEE - Institute of Electrical and Electronics Engineers, Inc.
- Uniform Building Code (UBC)/ Model Building Codes.
- ANSI/NFPA 70, National Electrical Code.
- ANSI/NFPA 80, Fire Doors and Windows.
- ANSI/UL 10B, Fire Tests of Door Assemblies.
- Other Codes as applicable

Manufacturer Qualifications: A manufacturer regularly engaged in manufacturing, installing, and servicing elevators of the type required for the project. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system. The manufacturer shall have a documented, on-going quality assurance program

Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than five years of satisfactory experience installing elevators equal in character and performance to the project elevators.

Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10 (b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

Inspection and testing:

1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
2. Arrange for inspections and make required tests.
3. Deliver to the Owner upon completion and acceptance of elevator work.

1.2 WARRANTY & MAINTENANCE

Special manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to restore, or replace defective elevator work within specified warranty period which is defined as one (1) year from date of Substantial Completion.

The warranty will consist of furnishing maintenance and call back service for a period of 12 months for each elevator from date of Substantial Completion as determined by consultant's acceptance.

1. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
2. Manufacturer shall have a service office and full time service personnel within a 50 mile radius of the project site.

1.3 DELIVERY STORAGE AND HANDLING

Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.

Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.4 MAINTENANCE SERVICE

Initial Maintenance Service: Beginning at Substantial Completion, provide one (1) year full maintenance service by skilled employees of elevator Installer. Include monthly preventive

maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. See Appendix I.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. All acceptable manufacturers are indicated in the individual equipment sections.

2.02 MATERIALS, GENERAL

Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

Steel:

1. Shapes and bars: Carbon.
2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
3. Finish: Factory-applied baked enamel.

Stainless steel:

4. Shapes and bars: No. 4 brushed or No. 8 polished stainless steel.
5. Tubing: No. 4 brushed or No. 8 polished stainless steel.

Aluminum:

1. Extrusions: Alloy 6063

Glass: Clear laminated safety glass, complying with ANSI Z97.1, nominal 9/16" thickness.

2.03 HOISTWAY EQUIPMENT

- A. Drilling and removal of the existing jack assembly shall be included in the Contractor's lump sum bid. Disposal of spoils shall be by a licensed and qualified vendor approved by the County and will be paid on a per barrel basis through the W-800- Miscellaneous Additional Work. Contractor shall submit copies of the disposal invoices to the County and will be paid the invoice amount + 10%.
- B. Provide new plunger and cylinder. The plunger shall be in a single jack arrangement with one jack located on the loading center of the underside of elevator. The units shall be of sufficient size to lift the gross load to the height specified plus factors of safety. The jack unit will be a synchronous type and shall be factory-tested for strength and leakage. Moving heads shall be designed to accept follower guides. The jack unit shall contain of an internally honed cylinder of seamless hydraulic grade tubing with concentric internal and external surfaces and uniform wall thickness. Moving cylinder/plunger

parts shall be seamless hydraulic grade tubing that is externally and internally honed. All external heads shall be mechanically locked to the cylinder. All seals shall be "low-friction-lip" type suitable for system pressure. Internal piston heads shall be welded or threaded to the pistons. Internal pistons shall form a hydraulic cushion with the limit sleeve at the top of each cylinder to prevent direct metal to metal contact at operating speed.

- C. Plunger(s) and Cylinder(s): The cylinder shall be constructed of steel pipe of sufficient thickness and suitable for the operating pressure. The top of each cylinder shall be equipped with a cylinder head with a drip ring to collect any oil seepage as well as an internal guide ring and self-adjusting packing. The bottom of each cylinder will be fitted with a heavy steel disc welded into place and provided with a suitable extended edge to provide positive stop designed to prevent plunger separation. Each plunger shall be constructed of selected steel tubing or pipe of proper diameter machined true and smooth with a fine polished finish. Each plunger shall be provided with a stop ring electrically welded to it to prevent the plunger from leaving the cylinder. Each plunger and cylinder shall be installed plumb and shall operate freely with minimum friction. External cylinder heads shall hold an internal guide ring, seal and wiper ring. A drip collection ring shall be formed into the top of each cylinder head. Any portion of the cylinder located below the pit floor and which cannot be visually inspected, shall be with and auxiliary safety bulkhead at the bottom of the cylinder.
- D. Provide state of the art code approved durable PVC Liner for the jack assembly to prevent direct metal to soil contact and to prevent a corrosive atmosphere.
- E. A steel packing gland with phenolic guide bearing, wiper ring and packing especially designed for hydraulic elevator service shall be provided. An oil collector system shall be furnished and installed to return leaked oil back to the storage tank.
- F. Remove existing hydraulic piping, valves, fixtures and mufflers and replace with new code compliant hydraulic piping, valves, fixtures and mufflers. Do not provide flexible hoses or assemblies.
- G. Car Guide Rails: Verify condition and sizing and reuse car and counterweight guide rails if acceptable. Make sure existing rails are properly fastened and reinforce as necessary with brackets and fasteners. Make any imperfections smooth.
- H. Spring Buffer: Helical coil spring type.
- I. Wiring: Wiring for hoistway electrical devices included in scope of the elevator system, hall panels, pit emergency stop switch, and the traveling cable for the elevator car. All wiring shall follow the latest applicable NEC Code. All conduits, boxes and covers shall be flame retardant and moisture resistant and shall be run in galvanized metal conduit or duct using strain boxes as required. All hoistway lighting is included.
- J. Hoistway Entrances -Reuse
 1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be UL fire rated steel. Additional sill angle support will be provided.
 2. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.

3. Fire Rating: Entrance and doors shall have a UL 1-1/2 hour fire protection rating.
4. Door and Entrance Finish: Lobby only- satin finish stainless steel. Frame & Door finish to be similar. **Clad the area around entrance in lobby in stainless steel. Other floors shall be painted.**
5. Entrance Markings: Entrance jambs shall be marked with 4" x 4" (102 mm x 102 mm) plates having raised floor markings with Braille adjacent. Markings shall be provided on both sides of the entrance.
6. Sight Guards: Black sight guards will be furnished.
7. Interlocks: Equip each hoistway entrance with a new approved type interlock, tested as required by code. Interlock shall be designed to prevent the opening the doors at any landing from the corridor side unless the car is at rest at that landing or is in the leveling zone and stopping at that landing. The operation of the elevator driving machine shall be prevented by means of opening the safety circuit, unless the shaftway door is locked in the closed position, except when the car is in the landing zone and is either stopped or being stopped. Interlocks shall be so located that they are not accessible from the landing side of the shaftway doors. Hoistway door unlocking devices shall be provided and be of the type specified by the governing code. All hoistway interlocks, contacts and unlocking devices shall have met all applicable functional and engineering tests required by the applicable elevator Code and all such equipment shall have been certified by a competent approved laboratory.
8. Reuse hoistway saddles on every floor. Damaged sills shall be replaced.
9. Door Hanger and Tracks, Sheaves, Closers, Rollers, Fascias, Astragals, Door Bumpers, Guards, Gibs, Dust Covers, Sight Guards, Jamb Markings, etc. Provide new hoistway door equipment and accessories on all doors. Damaged stainless steel sills will be replaced with new with proper supports. New vision glass guards permanently attached to each hatchway door will be installed. All cab and hatchway door Astragals shall be new.

K. Car Components

1. Car Frame & Sling: Provide new. Check that existing is provided with adequate bracing to support the platform and car enclosure. The buffer striking plate on the underside of the car-frame platform assembly must fully compress the spring buffer mounted in the pit before the plunger reaches its lower limit of travel.

2. Platform, Heavy Loading Type-new: The car platform shall be arranged to accommodate one-piece loads weighing up to 25% of the rated capacity, such as wheeled food carts, stretchers, x-ray equipment, etc. The platform shall be recessed 5/16" for flooring by others.
3. See drawings for Cab Enclosure for finish details
4. Emergency Car Lighting: An emergency power unit employing a 6 volt, sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car and provide current to the emergency siren in the event of building power failure. These must be connected to the cab lights.
5. Emergency Pulsating Siren: Siren mounted on top of the car that is activated when the Alarm button in the car operating panel is engaged. Siren shall have a rated sound pressure level of 80 dba at a distance of 3.0 m from the device. Siren shall respond with a delay of not more than 1 second after the switch or push button has been pressed
6. Exhaust Fan: A 2-speed exhaust fan shall be mounted on the car top.
7. Utility Outlet: A 125V, 20 amperes utility outlet with ground-fault circuit-interrupter protection shall be furnished on top of the cab.
8. Handrail: Flat Solid Metal 1/4" (6 mm) x 8" (203 mm) mirror finish stainless steel provided on the rear of the car enclosure.
9. Bumper Rail: Flat Solid Metal Bumper Rail 1/4" (6 mm) x 8" (203 mm) satin stainless steel provided on the sides and rear of the car enclosure.
10. Threshold Saddle: Stainless Steel.
11. Protective pad hooks and quilted fire retardant protective pads: Pad Buttons will be provided with non-suspended ceiling.
12. An electrical contact shall be provided on the car-top exit.
13. Kickplate for car doors of satin stainless steel.
14. Applied Reveal Finish - satin stainless steel.
15. Provide new UL rated car door with 16 Gage stainless steel #4 skin.

L. Guides

1. ELSCO

2. An approved equal

Provide roller guides, with a minimum of three tires six (6) inch roller type guide on the cab sling, shall be mounted on top and bottom of the car frame and be held in contact with the guide rail by adjustable devices. Bolt guide rails to the car frame at top and bottom of the slings. The guide roller shall be designed to operate on non lubricated guide rails.

M. Buffers

Provide new spring buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

N. Hoistway and Pit Lighting & Receptacles

Provide all new compact floor fixtures with guards. Provide ground fault indicator (GFCI) receptacles in elevator pit (except for sump pump), on top and bottom of elevator cab, overheads secondary spaces, machine rooms, etc as shown on drawings.

O. Emergency Terminal Limits

Place electric limit switches in the hoistway near the terminal landings. Limit switches shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing.

P. Automatic Self-Leveling

Provide each elevator car with a self-leveling device featured to automatically bring the car to the floor landings (+/- 1/4 ") and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic, accurate and independent of the operating device, provided that there is no interruption of power to the elevator. The car shall be maintained approximately level with the landing irrespective of its load or rope slippage. A pre-defined code compliant range should be arranged to safely move passengers.

Q. Traveling Cables

Provide new traveling cables, properly suspended by code approved Grips or steel cores and anchored as per manufacturer recommendations. The conduit must be fire resistant and the cables shall have a proper size loop and be free from contact with the hoistway construction, car and other equipment. For lighting circuits use 12AWG copper. All other wiring shall be 18AWG copper. All traveling cables shall contain 10% spare wires (no less than two spare wires for each type). The traveling cables shall have steel-supports and shall be run directly to the machine room, hung at the top of the hoistway at a distance of 6 feet from top of hoistway overhead. Traveling cable will be properly enclosed at the top hoistway and under the car with its steel core. Use a universal hanging system where applicable, (>200 feet). For hanging lengths of less than 200 feet, use rated grips sized for each traveler. Utilize manufacturer's installation procedure.

R. Cab Camera / Communications Wiring

Provisions shall be included for wiring for voice communication, music, cameras and monitors. Minimum Requirement (add 10% spares). The run will be from the cab bottom to the machine room and any other areas designated on any drawings or other specifica-

tions as part of this modernization, installed in separate junction boxes in all locations.
The

- a. Two (2) (CCTV) coaxial cables shown on drawings.
- b. Two (2) sets of twisted shielded cables as shown on drawings.
- c. All switches and related equipment.

Provide switches for safe operation & maintenance of the elevator, mounted in the hoistway, pit, overhead sheave rooms, secondary spaces and machine room as well as on the elevator cab sling and enclosure shall be replaced or added new as required for the new installation and Code requirements. All stop switches must be the push/pull design.

S. Switches

Provide switches for safe operation & maintenance of the elevator, mounted in the hoistway, pit, overhead sheave rooms, secondary spaces and machine room as well as on the elevator cab sling and enclosure shall be replaced or added new as required for the new installation and Code requirements. All stop switches must be the push/pull design.

T. Limit Switches

Provide limit switches which shall be silent when activated. All switches should be adjustable for future stopping modifications which shall conform to ANSI CODE requirements. Existing switches shall be removed. Rollers, if used, shall be equipped with engaging cams and provided with soft resilient type rollers for quiet operation. Provide terminal slow-down switches and wiring. Switches should be set to allow for a smooth stop. The normal limit switch shall be designed to bring the elevator automatically to a stop at the top and bottom terminal landings with any load up to and including 125% of the contract capacity and speed attained in normal operation. Final terminal stopping devices shall be designed to stop the car automatically, independent of all other operating devices, but with the buffers operative. When the final terminal stopping devices operate normal operation in either direction shall be prevented. In cases where the limit cam will obstruct the pit ladder, they will be re-located to the other side of the elevator

U. Provide overspeed valve as per code.

V. Provide any other switch/component required by current code.

W. Machine Room and Hoistway Heat detectors

Provide code approved hoistway heat detectors.

2.04 MACHINE ROOM EQUIPMENT

B. The machine room is located on the basement level as existing. All hydraulic oil plumbing and piping assemblies to be included in bid. Provide cut-off valves and all required fittings in the machine room and pit. Provide permanent pressure gage on the valve unit.

C. The hydraulic system shall be of compact design suitable for operation under the required pressure. The power component shall be of compact design mounted in the hydraulic-fluid

storage tank with all adjustment features accessible and oil level indicator. It shall include a constant displacement pump motor. A tank strainer in the suction line and a blowout proof muffler to reduce any pulsations. The pump and motor shall be directly coupled or connected by v-belt. The control valve shall control flow for up and down directions hydraulically and shall include an integral check valve. A control section including control solenoids shall direct the main valve and control: up and down starting, acceleration, transition from full speed to leveling speed, up and down stops, pressure relief and manual lowering. All of these functions shall be fully adjustable for maximum smoothness and to meet contract conditions. System to be provided with a muffler, low-pressure switch and a shut-off valve. The pump motors must be of A/C current type, fully submersible with necessary starting torque and low starting current. The motors shall be ruggedly constructed with all parts meeting or exceeding IEEE for rated motors. The motors shall operate the elevator system without overheating and shall maintain the elevator operating speed within acceptable parameters. Provide permanently plumbed rugged pressure gage with readings in psi.

D. A microprocessor-based controller shall be provided, including necessary starting switches together with all relays, switches, solid-state components and hardware required for operation, including door operation, as described herein. A three (3) phase overload device shall be provided to protect the motor against overloading.

E. A manual lowering feature shall permit lowering the elevator at slow speed in the event of power failure or for adjusting purposes.

F. Tank Heater/Cooler –Provide a tank heating/cooling system that will maintain oil temperatures within optimal operating parameters and prevent excessive heating or cooling of hydraulic oil.

G. Oil: Certified, EPA approved Bio-degradable oil shall be used. This oil shall be of non flammable type and shall not necessitate the use of a sprinkler system. Ten (10) gallons of spare oil shall also be provided. Low-oil control shall be provided which will be designed to automatically cause an up traveling car to descend to the lowest terminal landing if the system does not have a sufficient reservoir of oil.

The power operated car and hoistway doors shall automatically open at the lowest terminal landing to permit passenger egress. The doors shall then automatically close and all control buttons except the door open button in the car operating panel shall be made ineffective. This shall be able to be manually overridden.

H. Pressure Switch

I. Emergency Battery Lowering Device: Provide a device that will cause the elevator to descend quickly and smoothly to the lowest landing while keeping the doors closed until proper floor level is reached, and automatically opens door at lowest landing. It shall safely shut down elevator until normal power is restored, automatically reset for future emergencies and differentiates between power failure and manual operation of elevator disconnect switch.

During operation all elevator safety features required by code shall remain functional. The unit shall include the following:

1. Rechargeable Battery with LEDs and indicators.
2. Battery to provide basic power which shall be inverted and converted electronically. This power supply provides proper AC and DC voltages for emergency operation.
3. Automatic activation during loss of power.
4. Reverse phase and phase failure relay.
5. Provide 208 Volts and 110 Volts single phase 60Hz AC and 265 V DC or 130VDC.
6. Activate oil return circuitry.
7. Automatically maintains battery at proper charge.
8. Compatible with controller and other electrical/electronic elevator devices.
9. Non-interference producing. Acoustic and harmonic.
10. Wall-mountable vented cabinet with cover.
11. Field selectable output voltages.
12. Rugged plug-in PCBs.

J. Provide

- A heater with thermostat and on off switch in the tank and
- A code approved oil cooling unit with thermostat and on off switch in the machine room.

K. Provide details of required support beams, angles, plates, bearing plates, blocking steel members and all structured members. Any alterations required to properly support power unit, pumps and valves. Provide additional anchor bolts, templates and support beams for machine as required. Provide and related support steel. All bearings, steel, plates, mounting steel modifications and sheaves shall be included in the installation of the machine.

1. Isolation

Provide proper isolation for all mechanical and electrical equipment and any structural components, to prevent vibration, harmonic distortion, mechanical and electrical noise, audible noise and radio frequency interference to within acceptable limits of applicable code(s).

2. Labeling

Identify machine room components by number, as required by applicable codes and local regulations. All elevators, which have a designated device number by the Elevator Division of the Department of Buildings, must have a metal tag on all machine room equipment. This tag shall be in block type with a minimum of 1/4" height and securely attached in a permanent manner to the driving machine, controller, motor generator set or drive unit and the disconnecting means.

In addition, each elevator component shall be painted with the designated elevator letter. Each letter shall be four (4) inches in height and shall be located in a manner that recognition can be made from any area within the machine room.

3. Switch(es) – Main Line Disconnect & Auxiliary Disconnect

The contractor shall furnish and install new main line switches and wiring in the machine room. The main machine shall be visible from the main line switch. The main line switch shall conform to all codes and authorities having jurisdiction. The main line will have sufficient amperage to provide for all elevator equipment without overloading any piece of equipment. The main line will have proper breakers and shall be lockable in the open position. Contractor is to verify all power characteristics for proper sizing of the equipment. Provide auxiliary disconnect switches as per Code,

Contractor to verify that adequate power supply is available for the new system which includes, but is not limited to DC to AC conversion. Any discrepancies shall be brought to the Architect's attention.

4. Lighting – Machine Room

The contractor shall provide new fixtures that will provide adequate illumination intensity for safe movement and to perform needed work on machine room equipment. A switch shall be installed and located next to the machine room entrance which will control the lights. Light fixtures shall be installed above each piece of equipment such as machine, controller, governor and mainline switch panel to achieve properly distributed illumination for all equipment. Location shall be selected by Owner.

5. Electrical

Contractor shall review and test as necessary to verify the general compliance and sufficiency of electrical service and conformity with applicable codes. Breakers (Fusing) must be code compliant. Existing grounding, feeding service and distribution in the elevator machine room shall be reviewed and upgraded as per code and equipment requirements. Although the electric power supply details are provided elsewhere in these specifications, it is the responsibility of the elevator contractor to take all readings and measurements with proper instruments to determine actual electric loads of existing equipment. This information will be utilized to design and size the proposed new equipment by the contractor based upon actual current and voltages to prevent electrical tripping and elevator shutdowns with new equipment.

2.05 PASSENGER ELEVATOR CAR ENCLOSURE (see drawings)

A. Car Enclosure - General

1. Based upon Preliminary Load Test results the contractor shall determine the maximum cab weight that can be installed, without exceeding the load rating of the equipment, or without violating requirements of the Code.
2. Reinstall all equipment that is being retained if any. Provide and connect new elevator equipment being installed in the cab.
3. It is the responsibility of the Contractor to insure that all alterations shall not increase the original building design reactions by more than 5%.
4. Conduct final load test when all work has been completed.
5. Contractor shall statically balance the cab after refurbishment is completed.

6. All coordination with Owner/Architect/Consultant and subcontractor
7. Related work not specifically mentioned above to ensure a complete cab installation.

B. Cab Enclosure

1. Provide a cab based upon information specified herein to ensure timely communication and completion. Visit the County/Architect along with samples, designs and renderings based upon allowance to facilitate cab selection.
2. Hanging cab wall pads: One (1) set, durable and padded with durable masonite. The pads shall be designed to protect the cab interior during equipment moves. All accessories required for building personnel to hang pads must be included in each set.
3. Lighting: As indicated on drawings.
4. Cab Door: Provide new cab door panel constructed in rigid steel with cladding of Stainless Steel #4 Finish. All bolt hole patterns shall be pre-drilled and tapped. Provide "Z" brackets, Code mandated gibs & kick blocks.
5. Ventilation, Entrance Columns, Frieze Panels, base wainscoting, transoms & other design details.
6. Finish selection. As per drawings.

C. Contractor shall include all work and cab-related equipment specified elsewhere in this specification, as well as the following:

1. Permits, tests, fees, and all other costs required by the authorities having jurisdiction to complete the installation according to Code.
2. Flooring, Sub-Flooring, Sill (Saddle).
3. Car Door Hangers
4. Switches, Emergency Exit Switches.

D. Cab Saddle

The elevator contractor shall install new nickel silver cab saddle.

E. Car Top Inspection

Provide a car top inspection station with an "Emergency Stop" and Inspection/Automatic switch and constant pressure "safe", "up" and "down" direction buttons. The Inspection switch shall make the normal operating devices inoperative (including Fire Recall) when in the Inspection position and give the operator complete control of the elevator. Mount the car top inspection station to the cab crosshead or make it portable with a permanent and safe electrical cord. A minimum of 2 light fixtures permanently attached to different areas of the top of car for even lighting operated with one on/off switch and guards with proper brightness, fire buzzer and light inspection switches.

F. Emergency Exits

The cab shall have an emergency exit on the top of the cab enclosure as per code with electrical switch to stop the elevator when the door is opened. Mechanical locks shall be provided so that elevator passengers cannot exit without assistance. Provide fastening mechanism to anchor the hatch to the top of cab.

G. Signage

All elevator cabs shall be equipped with all code required signage. The following signs shall be engraved directly on to the cab pushbutton panels.

ID#, Capacity, No Smoking, Inspection Certificate Location, Direction for Fireman's Recall, Direction for Operating Communication System, Signage required by Owner or current code.

2.06 DOOR OPERATION

A. Door Operator.

Provide a direct or alternating current motor driven heavy duty solid state double closed loop operator designed to operate the car and hoistway doors simultaneously smoothly without a slam in both directions. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. In event of power failure, the mechanical door operating mechanism shall be arranged for instantaneous manual operation of car door and the hoistway door. The hoistway door shall continue during emergency operation to be self-locking and self-closing. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. The door shall be designed to operate at an average opening speed for 2 feet per second. This closing door speed must be adjustable keep the Kinetic Energy striking force to within industry standards. Provide rubber bumpers at both ends. Interlocks and safety contacts shall be provided.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel will reverse and the door will reopen to answer the other call.
4. Nudging Operation (Must have on/off capability. Keep normally off & turn on at Owner's request). The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.

5. Limited Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Car Door Operator Accessories

Provide new car door hanger track assemblies and header which shall be of the heavy duty type. All door accessories shall be approved. Two, two-point suspension sheave hanger roller assemblies, with related operating linkages, gate switch, clutch, zone lock and accessories shall conform to the applicable elevator Code requirements.

C. Door Protection Device:

1. Tritronic
2. An approved Equal

Provide a waterproof door protection system using 150 or more microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen. The device shall be designed and adjusted to minimize the possibility of injury to passengers and shall not project into hoistway door opening. A mechanical reopening device shall not be acceptable.

2.07 CAR OPERATING STATION

Flat, applied car operating panel shall be furnished. It shall contain a bank of round metal mechanical illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served, an emergency call button, door open and door close buttons, and switches for lights, inspection and the exhaust fan. Pan shaped design is not acceptable. Car operating panel shall not contain plastic housing components. The emergency call button shall be connected to a bell that serves as an emergency signal. All buttons to have raised numerals and Braille markings. Red LED halo illumination with Flat Flush buttons. Finish will be stainless steel.

The car station buttons shall become individually illuminated with L.E.D. type bulbs as a button for the desired floor is pressed. These lights shall be extinguished as the call is answered, or the demand is satisfied.

The alarm button with acknowledgement light and red emergency stop switch shall be located 35 inches from the floor, and control buttons not more than 54 inches from the

floor. Activation of the stop switch shall not cancel the registered car or corridor calls, and after the switch is released, the car shall continue to answer its registered. The entire system shall comply with all authorities having jurisdiction.

The car control in the car shall contain the devices required for specific operation. An inspection switch to make normal operation inoperative and allow use of the top-of-car operating station shall be provided. All switches not normally used shall be located behind a locked hinged panel. The following switches will also be provided; light, inspection, emergency light test, as well as a 110 A.C. outlet, 2-speed fan, attendant switch, up, down, and pass buttons, as well as all firemen's recall devices.

The panel shall consist of the following pushbuttons, key switches and indicators:

1. The bottom of the Car Operating Station shall contain a functional "door open," "door close," "alarm" buttons and a keyed "emergency stop" switch.
2. The Intermediate area of the station shall contain floor buttons which illuminate when a call is registered and remain illuminated until the call is answered. Raised floor indications and handicap symbols shall be located to the left and immediately adjacent to the floor buttons. No applied symbols or floor indications or symbols on the buttons shall be permitted.
3. The next level shall contain supplied options switches.
4. The top of the Car Operating Station shall contain fire service features, including operating instructions, in accordance with ASME A17.1 and local code.

A sounding button shall also be included on each cab panel to allow handicap persons the options of sounding an audible signal when passing each floor. Contractor must include all costs to modify cab wall to accommodate the new position of car station if existing cabs are being retained. The communication system will be provided with visual acknowledgements for the deaf.

- A. **Position Indicator:** A position indicator shall be contained above floor push buttons. As the car travels, its position in the hoistway shall be indicated by the illumination of the alpha/numeric character corresponding to the landing which the elevator is stopped at or passing.
- B. **Column Mounted Car Traveling Lantern:** A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound and illuminate when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close. The direction arrows shall be equipped with chimes, to indicate the direction that the car is traveling. An adjustable electronic chime shall be incorporated in the fixtures to sound as it is illuminated to call the attention of the waiting passengers. The arrows and electronic adjustable tone devices shall comply with applicable elevator Code requirements.

C. **Emergency Light:** Self-powered emergency light with an extra long life power-pack (rechargeable battery and automatic charger). The emergency light system may be incorporated into the cab pushbutton panel or as an alternate the emergency lighting system shall be designed to keep some ceiling lights on. The panel emergency light shall consist of white LED's and be capable of putting out a minimum of four (4) foot candles, one foot out and four foot in front of the car swing panel. The emergency light will illuminate automatically upon loss of the building's normal power supply. The system shall operate automatically when power failure is sensed. Any relocation or design change of this panel shall be included by the elevator contractor.

D. **Communications:**

Ring Communications

An Approved Equal

Provide an emergency communications device mounted integrally within the car station which shall include be a speaker in the cab pushbutton panel and an auto-dialer system. A two-way communications means between the car and a location in the building that is readily accessible to authorized and emergency personnel shall be provided. Means shall be provided to enable two-way voice communication between the machine room and the interior of the car. Location and type of system will be as per industry standards and subject to approval. The system shall be completely wired including all wiring, conduits electric, fittings, etc. Prior to modernization, the County retains the right to relocate the communication system.

The following will be furnished and installed: RMS 5000 EX with battery backup, Wall mounted unit, Two (2) AA916s for the machine room and security station for desk, AA 916 master station, and Car station mounted unit SS900B and AN 913 and Dialer DNA 934P. Telephone line will be connected to RMS 5000RX. The system shall be completely wired including all wiring, conduits electric, fittings, etc. Prior to modernization, the owner retains the right to relocate the communication system.

E. **Include the following special controls:**

1. Independent service switch.
2. Inspection switch.
3. Two speed fan/light switch.
4. Certificate frame.

2.08 CONTROL SYSTEMS

1. Motion Control Engineering
2. GAL
3. ESI
4. An approved Equal

A. **Controller:** The elevator control system shall be microprocessor based and software oriented. The system shall operate in real time, continuously analyzing the car(s) changing position, condition, and work load. All controller and operational circuits including the brake control and drive system shall be digital. Control of the elevator

shall be automatic in operation by means of push buttons in the car operating panel numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings

1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.
3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
4. A car that is stopping for the last hall call in the preference direction and that hall call is for the opposite direction with no onward car calls, shall reverse preference when the selector position advances to the landing at which the car is committed to stop. A car that is stopping for the last hall call in the preference direction, and that hall call is for the same direction, shall hold its preference until the door is almost closed allowing time for a passenger to register an onward car call which will maintain the preference. If no car call is registered before the door is almost closed, the car will lose its preference and shall be available to accept calls in either direction.

Note: The controller will be placed in the machine room as shown in the drawings. Wall mounted or floor mounted enclosure is acceptable provided the controller is secured from toppling over. The width of the controller shall not be more than 29" so as not to protrude into the space near the tank. Provide left handed door with enough hinge spacing for the door to open fully. Alternatively a top anchored pull handle door is acceptable.

B. Operation:

Simplex Selective Collective - ETA based. The system is optimized to get a car to the floor where a hall call or car call has been registered, in the shortest time. The system receives input information from standard call pushbuttons located in the hall, car position and car load information from individual car loadweighers.

- C. Load Weighing Device: Provide a load weighing device on each car which, when the particular car is filled to an adjustable percentage of the capacity load, shall cause the car

- to bypass landing calls but not car calls. The passed landing calls shall remain registered for the next following car.
1. The device shall be unaffected by the action of compensating chain or rope. The device shall detect a 15 pound (7 Kg.) load change under all conditions.
 2. The load sensor shall use a linear variable differential transformer to accurately measure the weight in the car. The information shall be transferred via a serial link to the elevator controller.
- D. Anti-Nuisance Call Control: The microprocessor control system shall evaluate the number of people on the car and compare that value to the number of car calls registered. If the number of car calls exceeds the number of people by a field programmable value, the car calls shall be canceled after the first call has been answered.
- E. Position Selector: The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slow down points in memory.
- F. Motion Control: The drive control system shall be dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit continuous comparison of machine speed to velocity profile and to actual car speed. This accurate position/velocity feedback shall permit a fast and accurate control of acceleration and retardation.
- G. All latest protection devices shall be provided which are code and industry approved.
- 2.09 HALL STATIONS-Remove existing and flush mount new at each landing. Include all work to make the stations flush mounted and ADA compliant.
- A. Hall Stations: Provide ADA compliant, "top of the line" buttons (subject to Owner approval) with illuminating LED halos to indicate that a call has been registered at that floor for the indicated direction. Provide engraving on hall buttons. Each terminal station shall contain one illuminating push button. Those lights shall operate individually to indicate that a call has been registered. The lights shall extinguish as the calls are answered.
1. Each intermediate station shall consist of two illuminating pushbuttons, one for the up direction and one for the down position.
 2. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
 3. Provide 1" illuminating LED position indicators at each hall station. Any additional position indicators shall also be replaced.

- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements and, when required by local code: Section 407 in ICC A117.1.
- C. Hall Position Indicator: Provide LED indicators on each floor.

2.10 HOISTWAY PIT

- A. Pit Ladders
Provide pit ladders in accordance with Code.
- B. Locate the ladder so as not to obstruct elevator operation.
- C. Pit Sump Pits and Sump Pumps
Provide new sump pump with oil minder in the pit and verify for proper operation. Provide an oil minder all work including electrical wiring to ensure a functional system to meet code required discharge rates. Provide oil minder. Run wiring in EMT or rigid galvanized steel conduit. Sump pump to be hard wired or connected to a non GFI outlet or as per code.

2.11 Electrical Wiring

Provide new wiring as per applicable edition of National Electrical Code. Terminal connections for all conductors at equipment panels, center of hoistway terminal blocks or studs shall have identifying numbers. Provide all wiring from the controller, selector, dispatching panels. Run all wiring in EMT or rigid galvanized steel conduit. Wiring shall be properly insulated and have flame-retarding and moisture-resisting outer cover and shall be run in galvanized metallic conduit or duct, using strain boxes as required. Each device will have a ground stud. See section 260519 Conductors and Cables.

2.12 Venting

Machine Room: Elevator machine rooms that contain solid-state equipment for elevator operation shall be provided with independent ventilation or air-conditioning system to protect against the overheating of the electrical equipment. The system shall be thermostatically controlled and capable of maintaining temperatures within the range established for the elevator equipment which will be stipulated by the selected manufacturer. (Typically 20,000 Btu).

Hoistway: Provide venting of the hoistway to the outside to meet applicable code requirements. The vent area shall be 3 ½ % of the cross sectional area of the elevator hoistway but not less than 3 square feet. Provide openings in the hoistway wall with louvers controlled by a thermostat and dampers as indicated on the drawings.

- 2.13 Toe Guards, Sight Guards and Additional Guards: Provide new toe guard which extend to the code mandated distance and shall be made of acceptable material and design
Sight Guards: Provide new sight guards as per code. Provide additional guards as required by code.

- 2.14 Hoistway heat detectors: The contractor shall furnish and install rated smoke detectors as required by code. Additionally heat detectors shall be provided in hoistway. These heat detectors shall be wired to initiate fire recall as per code.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and machine rooms, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Commencement of installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 INSTALLATION

- A. Install elevator systems components:
 - 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 - 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. Schedule work in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

- F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.
- G. Sound isolation: Mount rotating and vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent the transmission of vibrations to the structure, and eliminate sources of structure-borne noise from the elevator system.
- H. Alignment: Coordinate modification of hoistway entrances and elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- I. Lubricate operating parts of system, including ropes, as recommended by the manufacturer.
- J. Remove all old unused pipes wires and ducts and patch any damage caused by removal.
- K. Patch holes in hoistway.
- L. Bevel all ledges in hoistway as per code.
- M. Lubricate operating parts of system, including ropes, as recommended by the manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.
- B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.4 ADJUSTING

Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.5 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; shall not be cleaned with bleach-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

- C. Upon completion of the modernization, the machine room walls, ceiling and floors will be cleaned, primed and painted with flame and heat retardant paint. The pit floor will be completely cleaned sanded and painted with rust proof paint including all metal items.

3.6 PROTECTION

At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.7 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.8 Fireman Recall Key Switches & Operation

Fireman Recall buttons and key switches that will function in conjunction with the Fireman's Recall System will be provided in the Car Station and Lobby Hall Station. This will meet the latest New York State Fire Codes and any code changes that occur during modernization shall be retroactive. Tie-in to central panel is included as necessary. Emergency Fire Operation shall be designed to meet current code for Phase I & II operation. Emergency Operation shall equip the elevator with a control system to operate under, and/or recall the cars in fire or other emergency condition. All the features shall meet with the governing Firemen's Recall codes and Local Building codes. Emergency return to the lobby shall also be initiated with the Fire Emergency Procedures.

3.9 Independent Service

Provide independent service by providing the operating panel with a key operated switch. This key shall permit the car to by-pass all corridor calls and permit dispatching of the car directly to any floor by pressing the corresponding car button, when closed. The door shall not close until a car button is pressed or until the key operated switch is opened. Normal service shall resume, when key switched is opened.

3.10 Handicapped Requirements

- A. The American Disabilities Act (ADA), NYC Handicapped Code and other applicable requirements shall be complied with on all aspects of the Elevator Modernization.
- B. Alarm bell button and elevator emergency stop switch > 35 inches from floor level, and < 54 inches from the floor level.

- C. Braille markings shall be provided adjacent to the floor and control buttons on the car station panel. They shall be contrasting color background to the left of each button.
- D. All letters and numbers shall be a minimum of 5/8" and raised .03".
- E. The centerline of the hall pushbutton station shall be 42" above the floor when mounting boxes are replaced.
- F. The elevator directional lanterns illuminate their respective directions and sound once for the "up" direction and twice for the "down" direction. The elevator shall have an audible signal to tell passengers that the car is stopping or passing a floor served by the elevator
- G. On each floor landing, "Designations Signs" shall be placed on all entrances on both sides of jamb at a height of 60" above the floor.
- H. Designations Signs shall be 2" high, raised .03".
- I. An outside communication system shall be provided and installed by the contractor if the building does not have 24-hour building attendant.

APPENDIX I

APPENDIX I

GENERAL INFORMATION:

Elevator #	ID#	Classification	Rated Speed (Feet Per Minute) FPM	Capacity (lbs)	Machine Type	Floors Served
143 GRAND AVENUE, WHITE PLAINS, NY						
1	Passenger	Passenger	100	2,500	Conventional Hydraulic	B,1(Lobby),2,M

EQUIPMENT LOCATION:

Elevator #	Machine Room	Secondary	Rail Contact	Pit	Buffer Type	Jack Unit
143 GRAND AVENUE, WHITE PLAINS, NY						
1	Basement	N/A	Guide Shoes	Standard	Spring	Conventional Holed

MECHANICAL, ELECTRICAL, & DATA TAG INFORMATION

143 GRAND STREET, WHITE PLAINS, NEW YORK	
Elevator ID: Only Elevator	
<u>Main Line Amperage:</u>	60 Amps
<u>Fire Extinguisher Details</u>	Current
<u>HVAC</u>	Venting not per current code No Air Conditioner in Machine Room.
<u>Smoke Detector</u>	Machine Room
<u>Pit Sump Pump</u>	Yes
<u>Emergency Communications</u>	Yes
Machine	
Type:	Hydraulic Pump
Capacity:	2,500 lbs
Speed:	100 FPM
Controller:	
Type:	Automatic
Model:	Dover
Volts/ Phase:	208 Volts, 3 Phase
Power	10 HP
Year/Date Installed:	Unknown

SPECIFICATIONS GROUP

Facility Services Subgroup

DIVISION 21 - FIRE PROTECTION

Division	Section Title
210500	BASIC FIRE PROTECTION, STANDPIPE & SPRINKLER REQUIREMENTS
210517	SLEEVES AND SLEEVE SEALS FOR FIRE PROTECTION PIPING
210518	ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING
210523	GENERAL-DUTY VALVES FOR WATER BASED FIRE SUPPRESSION PIPING
210800	COMMISSIONING OF FIRE-SUPPRESSION
211313	WET-PIPE SPRINKLER SYSTEMS

END OF TABLE OF CONTENTS

SECTION 210500
BASIC FIRE PROTECTION AND SPRINKLER REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes general administrative and procedural requirements for mechanical installations.
- B. Submittal Procedures Section 013300

1.2 DEFINITIONS AND INTERPRETATIONS

- A. Definitions:
 - 1. This section assumes that a Construction Manager is reporting directly to the Owner and is authorized to act on behalf of the Owner as called out. In any situation where a CM is not a part of the project, all responsibilities called to be by the CM will be performed by the General Contractor reporting directly to the Owner.
 - a. For purposes of these Specifications the following definitions apply:
 - b. "Engineer" - the Engineer of record.
 - c. "Provide" - to "furnish" and "install."
 - d. "Install" - to receive; handle; rig; set in place; join; unite; fasten; link; attach; set up or otherwise connect together; complete, tested and ready for normal satisfactory operation including all labor inclusive of start-up and commissioning.
 - e. "Furnish" - to supply all materials, equipment, testing apparatus, controls, tests, commissioning, accessories, warranty and all other items customarily required for the proper and complete application.
 - f. "As directed" - as directed by the Architect or the Engineer.

- g. "Concealed" -embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings (including accessible ceilings)
- h. "Exposed" - not concealed (visible without removal of wall or ceiling)
- i. "Submit" - submit to the architect and/or the Engineer for review.
- j. "By Other Trades" or "Others" or "Oth" By persons or parties responsible for work at the project other than the party or parties who have been duly awarded the contract for the work of this trade. In the event that this document is used to acquire work as part of a general construction contract the words "by other trades" shall mean by persons or parties who are not anticipated to be the sub-contractor for this trade working together with the general contractor. In this context the words "by other trades" shall not be interpreted to mean not included in the overall contract.
- k. Where reference is made to "N.E.M.A. Standards," it shall be understood that this reference is to the "approved Standards," published by the National Electrical Manufacturers Association, Main Office-155 East 44th Street, New York, New York 10017.
- l. Where reference is made to "A.N.S.I. Standards", it shall be understood that this reference is to the standards published by the American National Standards Institute Incorporated.
- m. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- n. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.
- o. No exclusions from, or limitations, in the language used in the drawings or specifications shall be interpreted as meaning that the appurtenances or accessories necessary to complete any required system or item of equipment are to be omitted.

- p. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Work shown on all drawings including floor plans, riser diagrams, schedules and details is the responsibility of the contractor regardless of conflicts and coordination. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance mechanical drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings.
- q. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- r. Certain details appear on the drawings, which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
- s. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
- t. The use of words in the singular shall not be considered as limiting where other indications denote that more than one items is referred.

B. Abbreviations:

- 1. For purposes of these Specifications the following abbreviations apply:

MSDS	Materials Safety Data Sheet
MSS	Manufacturer's Standardization Society Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code (NFPA 70)
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety Health Administration
PDI	Plumbing and Drainage Institute

SAE	Society of Automotive Engineers
SMACNA Association	Sheet Metal and Air Conditioning Contractors National Association
TEMA	Tubular Exchangers Manufacturers Association
UL	Underwriter Laboratories
UPS	Uninterruptible Power System

1.3 RELATED DOCUMENTS

- A. Commissioning of Fire Suppression System Section 210800
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and other sections of Division 23.
- C. This section is a part of each Division 23 Section.
- D. Vibration and wind criteria for this section is referenced in specification, "Vibration Isolation for HVAC, Plumbing, and Electrical Components," section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.

1.4 QUALITY CONTROL

- A. Comply with Factory Mutual requirements.
- B. Comply with current governing codes, ordinances and regulations, as well as with requirements of EPA, U.L. and all other applicable codes.
- C. Comply with the requirements of agencies or authorities having jurisdiction over any part of the work and secure all necessary permits.
- D. Where codes or standards are listed herein, the applicable portions apply.
- E. Plans, specifications, codes and standards are minimum requirements. Where requirements differ, apply the more stringent.
- F. Should any change in plans or specifications be required to comply with governing regulations, notify the architect/engineer at the time of submitting this bid.

- G. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workmanlike manner by competent workmen. Provide a competent, experienced full-time superintendent who is authorized to make decisions on behalf of the contractor.
- H. All equipment and material to be furnished and installed on this Project shall be UL, ETL or any other recognized agency listed, and be suitable for its intended use in this project in accordance with the requirements of the City, state or any other Authority having jurisdiction.

1.5 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

- A. Air-conditioning and Refrigeration Institute (ARI).
- B. American National Standard Institute (ANSI).
- C. Air Moving and Conditioning Association (AMCA).
- D. American Society of Mechanical Engineers (ASME).
- E. American Society of Plumbing Engineers (ASPE).
- F. American Society for Testing and Materials (ASTM).
- G. American Association of Balancing Contractors (AABC).
- H. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
- I. American Welding Society (AWS).
- J. Cooling Tower Institute (CTI).
- K. Electrical Testing Laboratories (ETL).
- L. Environmental Protection Agency (EPA).
- M. Factory Mutual (FM).
- N. International Code Council (ICC).
- O. Manufacturers' Standardization Society Standards (MSS).

- P. National Environmental Balancing Bureau (NEBB).
- Q. National Electrical Code (NEC).
- R. National Fire Protection Association (NFPA).
- S. National Electrical Manufacturers Association (NEMA).
- T. 2020 New York State Building Code with local amendments.
- U. Occupational Safety and Health Administration (OSHA).
- V. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- W. Underwriters Laboratories (UL).

1.6 PROPOSALS AND ALTERNATES

- A. See the Contractor's and/or Owner's "Instructions to Bidders" for Allowances, Unit Prices and Alternates.
- B. Compliance Reviews: The contractor and equipment vendor shall provide a Compliance Review with the bid proposal of the applicable Drawings, Specifications and Addenda and for all equipment and alternates listed hereinafter for this Project. The Compliance Review will be paragraph-by-paragraph review of the Specifications with the following information, "C","D","E" or "N/A," marked for each Specification section paragraph in the margin of the Specification and any subsequent Addenda.
 - 1. "C": Comply with no exceptions.
 - 2. "D": Comply with minor deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 - 3. "E": Exception. Equipment, product or material does not comply. For each and every exception, provide a numbered footnote with reasons for the exception for the Owner's consideration and possible alternatives.
 - 4. "N/A": The specification paragraph does not apply to the proposed equipment, material or product.

5. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the equipment proposed for this project is in complete compliance with the Contract Documents. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradictions do not release the Contractor from being in complete compliance, unless the exception or deviation has been specifically noted (explicitly, not by implication) in the Compliance Review.

C. Equipment Alternatives:

1. Request for Substitution - Contractor initiated change to specified equipment or system for which the Owner/Architect/Engineer reserve the right to reject without review. Requests for Substitution must comply with the following:
 - a. Submit proposals to supply substitute materials or equipment, in writing, to the Construction Manager. Include the following information with the proposal:
 - 1) A description of the difference between the contract document requirements and that proposed listing the comparative features of each, including operating cost impact and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of implementation costs.
 - 2) A list of the contract requirements that must be revised if the substitution is accepted, including any suggested specification revisions. Include a description and estimate of costs the engineer of record may incur in implementing the proposed substitution.
 - 3) Include a description and estimate of costs the Owner may incur in implementing the change, such as test, evaluation, operating and support costs.
 - 4) A projection of any effects the proposed change would have on collateral costs to the Owner.
 - 5) A statement of any effect on the contract completion time or the delivery schedule.
 - 6) A statement indicating the reduction to the contract price if the Owner accepts the change. Be responsible for appropriate modifications to all trades.

2. Include all revisions required to adapt substitutions in such proposals, including revisions by other trades. Only substitutions that reflect equal quality with a lower contract price and/or decreased operating costs will be considered.
3. Wherever operating results such as quantity delivered or pressure obtained are scheduled, or when the make and size of apparatus, for which such quantities are readily determinable, is specified, the substitution being proposed must conform substantially to the quantities specified or implied. The substitution must fit into available space conditions and must function properly in coordination with the rest of the system.

1.7 DRAWINGS

- A. The Drawings show the general layout of the various items of Fire Protection System. However, layout of equipment, accessories, specialties, etc. are diagrammatic unless specifically dimensioned and do not necessarily indicate every required fitting, support or similar items required for a complete installation. Consult the Architectural Drawings and details for exact locations of fixtures and equipment. Where same is not definitively located, obtain the information from the Architect before proceeding. Any reasonable changes in locations indicated shall be made by the Contractor without additional cost to the Owner, if such changes are ordered prior to performance of the affected Work.
- B. The Contractor shall follow the Drawings in laying out the Work and check Drawings of all trades to verify spaces in which Work will be installed. Maintain maximum headroom and where space conditions appear inadequate; the Architect shall be notified before proceeding with the installation.
- C. Equipment shown on the Drawings has been coordinated for structural penetrations, electrical connection, operating and service (maintenance) requirements and physical size with regard to the space where the equipment is shown. If they comply with the Specifications, these and the other specified manufacturers of this equipment will be acceptable contingent on the Contractor providing a complete installation and maintaining full responsibility to provide, at no additional cost, any modifications to the Architectural, Structural, Mechanical & Electrical Systems that are required to properly install, operate and service the equipment being used. These modifications shall not include additional area for equipment unless approved by the Architect.
 1. The Contractor shall note these changes on the equipment submittals and the Compliance Review and shall show all differences in equipment being supplied from that specified and shown on the Drawings. Failure of the Contractor to provide this information with the submittal will indicate the submitted equipment meets or exceeds the requirements of the equipment shown on the Drawings in performance and is physically no larger in housing size.

- a. Failure of the Contractor to comply with the above and any discrepancies found should result in the Contractor providing equipment equal to that specified at the Contractor's expense.

1.8 GENERAL PROJECT REQUIREMENTS

A. General: The following information is required for review by the Owner, Architect and Engineer and is to be provided as it applies to this contract. It does not address items that may be required by the Construction Manager such as daily reports, minutes to safety meetings, etc.:

1. Requisition Breakdown (include material quantities relative to each area i.e., length of pipe or pounds of sheet metal)
2. Unit Prices (prior to contract award)
3. Wage Rate Breakdowns (prior to contract award)
4. Projection of manpower loading
5. Statement of review and acceptance of project schedule and task durations
6. Site Safety Plan
7. Submittal log – Including listing dates of shop drawing submittals for Owners insurance carrier Factory Mutual review and 2020 New York State Codes filings
8. Submittal data as defined below
9. Drawing plot plan
10. Coordination drawing log
11. Proposed sub-contractors list
12. Equipment manufacturer and material supplier list
13. Requests for substitution
14. Manufacturer's Compliance reviews
15. Contractor Certification forms

16. Manufacturer's Certification forms
17. List of samples to be submitted
18. List of all permits to be provided (i.e., for NYC projects include TR-1 forms, Equipment Use Permits, DOB Filings, etc.)
19. List of all engineers providing sign-offs, certifications, and Controlled Inspections
20. Sleeve and Slab penetration drawings
21. Details and locations of embeds
22. Equipment pad location and sizing drawings
23. Drawings showing point loading of equipment and hung supports in excess of 200 pounds
24. Pipe and Conduit expansion drawings and calculations
25. List of items proposed to be ship fabricated along with skid details (Provide spool details on request)
26. Shop Standards
27. Material Standards
28. Welding procedures and list of certified personnel with record of certification of steam piping is the responsibility of this contractor. Submit copies of all reports and approvals on completion.)
29. Coordination drawings
30. Testing procedures including deferred testing (seasonal or out of sequence based on maintaining job progress schedule)
31. Alignment reports
32. Manufacturer's factory test reports
33. Manufacturer's and contractor's start-up reports
34. All MSDS forms for materials brought on site

35. List of all fuse sizes prior to start-up
 36. Spare parts lists
 37. O&M manuals
 38. Valve tags list and Charts
 39. As-built drawings
 40. As-built reflected ceiling and floor drawings showing access door locations indicating type and nature of concealed device
 41. Manufacturer's standard warranty along with signed acknowledgement of modified terms per this contract
 42. Contractor warranty
 43. Training Outlines and Agenda
 44. Commissioning pre-functional testing forms
 45. Commissioning logs and test results
 46. Certified Project Record Documents
 47. Updated Equipments Schedule Sheets
 48. Notice of completion
 49. Prepare submittals according to the Conditions of the Contract and as specified in Division 013300 Section "SUBMITTAL PROCEDURES."
- B. The Division 21 Contractor shall submit a complete typed list of all Fire Protection equipment manufacturers and material suppliers for the equipment and materials they intend to furnish and install on this project for review by the Owner/Architect/Engineer prior to the award of the contract.
- C. Each Contractor shall prepare an index of all Division 21 submittals for the Project. The index shall include a submittal identification number, a cross-reference to the Specification Section or Drawing number and an item description. The submittal identification number shall be prefixed by the applicable Specification Section. Each submittal shall bear the submittal identification number in addition to the other data specified. All consultants, the Owner and all Contractors

will utilize the assigned submittal identification number. If an expedited submittal review process is implemented on this Project, the equipment manufacturers, material suppliers list and submittals index will have to be submitted early to meet the requirements of the expedited submittal review procedure.

- D. Upon receipt of the approved manufacturers and material suppliers list, the Contractor shall immediately obtain complete Shop Drawings, Product Data and Samples and equipment and material Specification Compliance Review documents from the manufacturers, suppliers, vendors and all Division 23 Contractors, for all materials and equipment as specified herein in various sections of the specifications and shall submit data and details of such materials and equipment for review by the Architect and Engineer. Prior to submission of the Shop Drawings, Product Data and Samples to the Architect and Engineer, the Contractor shall thoroughly review the Shop Drawings, Product Data and Samples and verify they are in compliance with the Contract Documents. The Contractor shall provide a compliance review provided with the Contractor's Compliance Review will be a paragraph-by-paragraph review of the specifications with the following information marked for each Specification section paragraph or in the margin of the original Specification and any subsequent Addenda.
1. "C": Comply with no exceptions.
 2. "D": Comply with minor deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 3. "E": Exception. Equipment, product or material does not comply. For each and every exception, provide a numbered footnote with reasons for each exception and suggest possible alternatives for the owner's consideration.
 4. "N/A": The specification paragraph does not apply to the proposed equipment, material or product.
 5. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Contractor is in complete compliance with the Contract Documents. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not.
 6. The Contractor shall check all materials and equipment upon their arrival on the Project Site and verify their condition and compliance with the Contract Documents. Any work, which proceeds prior to receiving "Approved", Shop Drawings shall be modified as required to comply with the Contract Documents and the "Approved" Shop Drawings. A minimum period of fifteen (15) Working days, exclusive of transmittal time, will be required in the Engineer's office each time a Shop Drawing, Product Data and/or Sample

is submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling his work.

7. The review of Shop Drawings, Product Data and Samples by the Architect and Engineer shall not relieve the Contractor of the responsibility for dimensions of errors that may be contained therein for deviations from requirements in the Contract Documents. It shall be clearly understood that the noting of some errors by the Engineer but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, Product Data and Samples, the Contract Documents shall govern the Work and are neither waived nor superseded in any way by the review of Shop Drawings, Product Data and Samples.

1.9 COORDINATION DRAWINGS

- A. The Contractor and all Subcontractors shall prepare a complete set of construction coordination drawings ("Coordination Drawings") indicating the equipment actually purchased and the exact routing and elevations for all lines such as piping, busway conduit, ductwork, etc., including conduit embedded in concrete and openings, sleeves, etc., required in the structure, walls, partitions, etc.
- B. The Coordination Drawings shall be submitted complete for demonstration of compliance to the Architect, Engineer, and Owner. All structural elements, footings, slab elevations and thickness shall be indicated.
- C. The sheet metal drawings prepared on electronic media (CADD) for printing at a scale of not less than $3/8" = 1'-0"$ on a 36" x 48" drawing and shall serve as the base Drawings to which all other Contractors will overlay and add their Work. Each trade shall draw their Work on separate layers represented by individual colors. Each Coordination Drawing shall be completed and signed off by other Contractors and the Contractor prior to the installation of the Work in the area covered by the specific Coordination Drawing.
- D. Any Work installed before coordinating with the Work of the other trades, shall be subject to removal and re-installation as required to correct the condition without extra cost to the Owner.
- E. The Coordination Drawings shall indicate piping, conduit, busway and equipment support points and loads exceeding 500 lb. imposed on the building structure. Drawings shall be submitted to the Architect and Engineer of record for review. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points and the size of all lines shall be indicated. All beam penetrations, slab penetrations and sleeves shall be indicated, sized and coordinated with all other Work. All required code clearance space and required maintenance access space shall be indicated and

coordinated with all other work. All Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated.

1.10 RECORD DOCUMENTS

- A. The Contractor shall maintain on a daily basis at the Project Site a complete set of Project Record Documents. The Project Record Documents shall consist of continuously updated AutoCAD files of the Coordination Drawings for this Division. The AutoCAD files shall be electronically updated by the Contractor's technician during the construction period to show the precise location of all buried or concealed work and equipment, including embedded piping and valves, field modifications and all changes and deviations in the Mechanical work from that shown on the Contract Documents.
- B. The Contractor shall maintain on site a record of testing records, and pre-functional and functional testing forms and records.
- C. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without written definite instructions from the Architect or Engineer. Prior to commencing work, the Contractor shall obtain from the Architect or Engineer a set of AutoCAD format Drawings on compact disks, to be used only to produce the Coordination Drawings. The continuously updated Coordination Drawings shall be used to produce the final Project Record Documents, which shall be delivered to the Owner in latest version AutoCAD format CD-RW Recordable Rewrite Compact Discs upon Final Completion of the Project. The Contractor shall give to the Architect and Engineer a written release acceptable to the Architect and Engineer signed by a corporate officer of the Contractor prior to receipt of the Architect's and Engineer's compact disks.
- D. Record dimensions shall clearly and accurately delineate the work as installed; locations shall be suitable identified by at least two (2) dimensions to permanent structures.
- E. Prior to final acceptance of the work of this Division, the Contractor shall submit properly certified Project Record Documents to the Architect and Engineer for review and shall make changes, corrections or additions as the Architect and/or Engineer may require to the Project Record Documents. After the Architect's and Engineer's review and any required Contractor revisions, the Project Record Documents shall be delivered to the Owner on CD-RW Recordable Rewrite Compact Discs in latest AutoCAD format.
- F. Prepare project record documents in accordance with the requirements in Division 1 and as specified herein. In addition comply with the following.

1. A complete set of “as-built” or record drawings shall be made up and delivered to the Architect.
2. The drawings shall show:
 - a. Piping systems, with valves, control devices, floor control assemblies, Tamper flow switches, located and numbered as shown on plans, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section “Mechanical Identification.” Indicate horizontal locations of underground piping.
 - b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - c. Actual equipment and materials installed.
 - d. This trade shall submit the as-built project record documents set for approval by the building department in a form acceptable to the department, when required by the jurisdiction.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall provide operating instructions and maintenance data books for all equipment and materials furnished under this Division as well as assist the CA in compiling and consolidating O&M information during the development of the site specific Commissioning Plan.
- B. Deliver two (2) initial copies of the operation and maintenance manuals to the Owner and Engineer for review with the equipment submittals. The initial copies shall contain all the information available at the time of submission.
- C. Submit six (6) final copies of operation and maintenance manuals to the Owner and Engineer for review at least two (2) months prior to training along with the training outlined. Assemble all data in a completely indexed volume or volumes in three ring binders and identify the size, model and features indicated for each item. The binders shall have the Project Name and Logo printed on the outside of the binders. Re-submittals of these final size (6) copies of the “Approved” operation and maintenance books and two (2) electronic CD-RW recordable rewrite compact disc shall be delivered to the Owner upon Final Completion of the Project.

Vendor / Manufacturer shall supply complete operations and maintenance manuals in accordance with the following requirements:

1. The operations and maintenance manual documentations shall be presented in an Avery 3" heavy duty white binder or equivalent at the time of original submission, and record manuals within four weeks of integrated delivery of equipment to the site.
2. The binder shall have a cover page depicting the system(s) covered by the manual, the name, site location, and date.
3. The binder shall contain a detailed table of contents page delineating all major sections of the manual. Each section of the manual shall have an Avery narrow tab type divider placed between sections (properly labeled) to ensure easy access. The major sections of the manual shall include:

D. Include the following information where applicable:

1. Manual index
2. Specification Section reference number and index.
3. Equipment and/or material model number and serial numbers.
4. Identifying name, mark number, plan/drawings tagging, etc.
5. Locations of major equipment (where several similar items are used, provide a list).
6. Manufacturer's catalogue literature including model, type, style, complete standard factory operations manual, brand name data, etc.
7. Installation manual
8. Operations manual
9. Maintenance manual with lubrication charts, and recommended periodic maintenance and schedules.
10. Detailed sequences of operation for all operating modes.
11. Supplier, dealer, distributor, vendor and service organizations including phone, fax and e-mail addresses and name of contact person.
12. "Approved" or approved submittals.
13. Dimensional drawings with equipment weights

14. List of spare parts recommended for normal service requirements.
 15. Reduced scale building standpipe and sprinkler riser diagram and floor plans.
 16. Manufacturer's recommended operation and maintenance instructions with all non-applicable information deleted.
 17. Trouble shooting diagnostic instructions where available.
 18. Copy of as builts of installation throughout.
 19. Copy of all welding certifications.
 20. Copy of all warranties and guarantees.
 21. Copy of all factory and field test reports.
 22. Completed Functional Test sheets.
 23. Completed Pre-functional checklists.
 24. Copies of all "Data Register" Sheets (see Specifications 230593, Testing, Balancing and Adjusting, Part 1, General, Submittals, Item E.1. (d))
- E. Items required for inclusion in the operations and maintenance manuals that cannot be provided at the time the O&Ms are initially submitted for review are expected to be submitted within ten (10) weeks of completion of the work in a format for insertion into the binder under a pre-fabricated tab that is identified in the table of contents (i.e. The site acceptance test may not be complete at the time this manual is required for submission, in this case the manufacturer shall submit the manual with this section empty, upon completion of the site acceptance testing the forms for this testing will be supplied (punched for the binder).
- F. All documents shall be submitted electronically by computer disk in a dedicated sleeve within the binder.
- 1.12 CODES, PERMITS AND INSPECTIONS
- A. All work shall meet or exceed the latest requirements of all national, state, county, municipal and other authorities exercising jurisdiction over construction work at the project. These include, but are not limited to the following;

1. NFPA National Fire Codes – NFPA 13 2016, NFPA 14 2016, NFPA 20 2016 as modified by New York State Building codes.
 2. New York State Department of Health Westchester County.
 3. Local Fire Department.
 4. Village of Dobbs Ferry.
 5. Owner’s Insurance Underwriter.
- B. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the work.
- C. Any portion of the work, which is not subject to the approval of any authority having jurisdictions, shall be governed by the applicable sections of the overall National Fire Code, as published by the National Fire Protection Association.
- D. Installation procedures, methods, and conditions shall comply with the latest requirements of The Federal Occupational Safety and Health Act (OSHA).
- E. Prepare and submit to the Architect, Owner or Engineer as-built project record documents in a form acceptable to Architect and Engineer. Drawings shall clearly indicate final fire protection standpipe hose valves, fire hose cabinet and key box locations, sprinkler heads and sprinkler head counts , identification, signed and sealed and hydraulic calculations and record flow test data shall be provided for all systems. Documents shall be provided a minimum of 4 weeks prior to T.C.O. or as requested from authorities having jurisdiction.

1.13 SEQUENCING AND SCHEDULING

- A. Coordinate fire protection equipment installation with other building components and spatial requirements.
- B. Arrange for chases, slots and openings in building structure during progress of construction to all for fire protection installations.
- C. Coordinate the installation of required supports and sleeves in poured place concrete and other structural components.
- D. Sequence, coordinate and integrate installations of fire protection materials and equipment for required flow of work schedule. Coordinate installation of large equipment requiring final placement prior to closing in of building or building sections.

- E. Coordinate connections for electrical requirements for complete installation and operation of fire protection systems.
- F. Coordinate requirements for access panels. Doors where fire protection items requiring access are concealed behind finished surfaces.

1.14 FIRE FLOW TEST

- A. The fire protection contractor shall perform up to date fire flow tests indicating the static and residual pressures in the water mains used for fire service with certified flow volumes at the time of the test. Test must be conducted at near peak or demand times of day. Tests shall be performed in accordance with NFPA standard 13 and 14.
- B. Fire flow test data must be used in conjunction with the contractors' hydraulic calculations. Calculations shall include the dynamic (rated) and static (churn) flow conditions.

1.15 COORDINATION OF WORK BETWEEN TRADES

- A. The Fire Protection Trade is required to supply all necessary supervision and coordination information to any other trades who are to supply work to accommodate the Fire Protection Trade installations.
- B. The Fire Protection Trade is required to supply all necessary supervision and coordination of all other trades required for the storage, transportation, installation, start-up, testing and commissioning of pre-purchased equipment.
- C. Where the Fire Protection Trade is required to install items, which it does not purchase, including pre-purchased equipment, it is required that this contractor assumes all responsibilities associated with the equipment as if they had purchased the equipment directly. This shall include but is not limited to the following:
 - 1. The coordination of their delivery including prior notifications and overseeing the filing of all claims.
 - 2. Equipment is to be purchased inclusive of freight to an initial point of delivery. Contractor is to coordinate and assumes all costs for receipt at, storage at, and transportation to the site from a rigger's yard.
 - 3. Their unloading from delivery trucks driven in to any designated point on the property line at grade level.

4. Their safe handling and field storage up to the time of permanent placement in the project.
 5. Their protection and periodic maintenance up to the time of Owner takeover o these responsibilities as defined by start-up, Owner acceptance, and warranty conditions defined herein.
 6. The correction of any damage, defacement or corrosion to which they may have been subjected.
 7. Their field assembly and internal connection as may be necessary for their proper operation.
 8. Their mounting in place including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
 9. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
 10. All labor including but not limited to installation, start-up, commissioning and warranty.
 11. Any and all documentation to be provided as required by the contract documents.
- D. Items, which are to be installed but not purchased as part of the work of the Fire Protection Trade, shall be carefully examined by this trade upon delivery to the project. Claims that any of these items have been received in such condition that deviates from information previously provided that their installation will require procedures beyond the reasonable scope of work of the Fire Protection trade will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The work of the Fire Protection Trade shall include all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.
- E. Where multiple contracts are awarded involving the same trade for either base contract work or tenant fit-out, contractors shall coordinate their work and provide sufficient labor for the testing of the system as a whole.
- 1.16 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

- B. Unit shall be stored and handled in accordance with manufacturer's instructions.
- C. Unit shall be shipped with all listed items and control wiring factory installed unless noted on the submittals and approved prior to shipment.
- D. Unit shall be shipped complete as specified. Parts for field installation shall not be shipped and stored on site without prior to shipment.
- E. Rigging: Units shall be fully assembled. Units requiring disassembly for rigging shall be factory assembled and tested. Disassembly, reassembly and testing shall be supervised by the manufacturer's representative.
- F. Unit shall be shipped with firmly attached labels that indicate name of manufacturer, model number, serial number, and plan tagging.
- G. The Vendor shall shrink-wrap all electronic equipment and spare parts prior to shipping. Spare parts are to be delivered at time of owner acceptance.

1.17 PRE-CONSTRUCTION CONFERENCE PRIOR TO START OF WORK

- A. Prior to commencing any work, the CM, together with designated major Contractors, shall confer with the Architect and Engineer concerning the work under the Construction Contract.
- B. The pre-construction conference will be conducted under the leadership of the CM and will occur soon after the CM notifies the Subcontractors of contract award. The pre-construction conference will focus on items such as the expedited submittal review procedure, interface and coordination between Contractor work scope, the CM's project site rules and requirements, temporary utility requirements, CM's construction schedule, packaged modular plant etc.

1.18 GUARANTEES, CERTIFICATIONS AND WARRANTY PERIOD

- A. Contractors and their Manufacturers shall provide a 1-year full parts and labor warranty, one year labor and warranty minimum after full system start up. Contractor must maintain a local full time service company with 24-hour emergency service capable of responding to service needs within 4-hours. Contactor shall be aware that during the full warranty period as defined above, Manufacturers of certain pre-purchased equipment as called for in purchase agreements by the CM are to provide all required periodic and routine service and maintenance. The Manufacturers through the Contractor shall submit a service and maintenance plan for approval by the Owner. The Manufacturer must comply with the requirements of Owner's Service Contract terms and conditions. When purchase agreements are made the responsibility of this Contractor, all service agreements called for in specification sections shall be made part of the

initial purchase and shall pass directly to the Owner. All other equipment, systems and related appurtenances shall be the responsibility of the Contractor for warranty. All warranty claims whether for pre-purchased or direct purchased equipment shall be the responsibility of the Contractor.

- B. During the warranty period, the Contractor shall guarantee the following in a form satisfactory to the Owner:
 - 1. All work installed will be free from any and all defects in Workmanship and/or materials.
 - 2. All apparatus will develop capacities and performance characteristics specified.
 - 3. The systems shall operate without malfunction.
- C. The Contractor shall, without cost to the Owner, remedy any defects within a reasonable time to be specified in notice from the Architect. In default thereof, the Owner may have such Work done and charge all costs to the Contractor.
- D. The start of the Contractor's warranty period, as defined above, shall have no restrictions on start date and extend for the full period noted.
- E. The Contractor shall confer with the CM prior to the bid date concerning the Schedule and determine if there is a need to operate any items of equipment or systems for temporary heating and/or cooling or other reasons prior to substantial completion. All required extended warranty costs for equipment, materials and systems shall be included in the Contractor's proposal and clearly designated with a breakout price. All equipment or systems used for temporary heating and/or cooling shall be restored to "as new" condition by this Contractor and all associated costs shall be included in the Contractor's bid proposal.

1.19 CONNECTIONS TO EXISTING WORK

- A. Plan installation of new work and connections to work previously installed or put in place by others to insure minimum interference with regular operation of existing and surrounding facilities. Submit to the Owner for approval, date schedule of necessary temporary shutdowns of existing services. All shutdowns shall be made at such times as will not interfere with regular operation of existing facilities and only after written approval of Owner. To insure continuous operation, make all necessary temporary connections between new and existing work. All costs resulting from temporary shutdowns shall be borne by this Contractor.
- B. All shutdowns shall be done on overtime.

- C. The drawings may not utilize symbols and schematic diagrams to indicate connections to existing work. If used, these do not have any dimensional significance nor do they delineate every item required for the intended installations nor do they represent a division of responsibility between contracts.
- D. The contractor shall coordinate all connections to existing work with the CM. Contractor shall field verify exact location of all existing services.
- E. Connect new work to existing work in neat and approved manner. Restore existing work disturbed to original condition.

1.20 FINAL REVIEW AND ACCEPTANCE

- A. At a time designated by the Owner and after Commissioning of the systems, the entire system will be reviewed for compliance with the Contract Drawings and Specifications. The Contractor shall be available at all times during this review.
- B. Prior to the Final Review field visit, the Contractor will submit to the Engineer a written certification that: 1) attests to the Contract Document compliance for this Project prior to the Engineers Final Review field visit, and 2) certifies that the equipment and materials installed in this project under this Division contain no asbestos or P.C.B.
- C. Operate the entire system properly with all systems completed for a minimum period of 10 days.
- D. Certificates and Documents required herein to be in order and presented to the Engineer at least two (2) weeks prior to the Final Review.
- E. After the Final Review, any changes or corrections noted as necessary for the work to comply with the requirements of the contract documents are to be accomplished without delay in order to secure final acceptance of the work.

END OF SECTION

SECTION 210505

SPRINKLER UNIT PRICES

PART 1 - GENERAL

1.1 UNIT PRICES

- A. Submit separate unit price quotations for each of the various items hereinafter listed.
- B. Unit price quotations shall be suitable for additions and deductions.
- C. Except where specific exceptions are indicated, it shall be understood that the equipment, materials, installation methods, etc., required for unit quotation items are to be identical to those called for under the base bid.
- D. Itemized list of items for which unit price quotations are required is as follows:

1. Schedule 40 Steel Piping - per linear foot

- a. 1" diameter \$ _____
- b. 1-1/4" diameter \$ _____
- c. 1-1/2" diameter \$ _____
- d. 2" diameter \$ _____
- e. 2-1/2" diameter \$ _____
- f. 3" diameter \$ _____
- g. 4" diameter \$ _____
- h. 6" diameter \$ _____

2. Ball Valves

- a. 2-1/2" diameter \$ _____
- b. 3" diameter \$ _____

- c. 4" diameter \$ _____
- d. 6" diameter \$ _____
- 3. Check valve with auto ball drip \$ _____
- 4. Gate Valves - each
 - a. 2-1/2" diameter \$ _____
 - b. 3" diameter \$ _____
 - c. 4" diameter \$ _____
 - d. 6" diameter \$ _____
- 5. Furnish and install sprinkler heads 5.6K per head including up to 10 feet of 1" horizontal piping and vertical drop:
 - a. Upright head \$ _____
 - b. Pendant concealed head \$ _____
 - c. Sidewall head \$ _____
- 6. Furnish and install sprinkler heads 8.0k per head including up to 10 feet of 1-1/4" horizontal piping and vertical drop:
 - a. Upright head \$ _____
 - b. Pendant concealed head \$ _____
 - c. Sidewall head \$ _____
- 7. Furnish and install sprinkler heads 11.0k per head including up to 10 feet of 1-1/4" horizontal piping and vertical drop:
 - a. Upright head \$ _____
 - b. Pendant concealed head \$ _____
 - c. Sidewall head \$ _____
- 8. Removal of existing heads

- a. Remove and replace head only for each type \$ _____
- 9. Floor Control Assemblies with drain and test \$ _____
- 10. Fire Drilling and Fire Stopping Penetrations
 - a. 2" diameter \$ _____
 - b. 3" diameter \$ _____
 - c. 4" diameter \$ _____
 - d. 5" diameter \$ _____
 - e. 6" diameter \$ _____
 - f. 8" diameter \$ _____
 - g. 10" diameter \$ _____

E. In addition, provide unit quotations to cover authorized additional sprinkler work performed on a "time and material" basis as follows:

- Labor \$ _____
- Per man hour \$ _____
- Regular working hours labor \$ _____
- For one man working one hour during stipulated time \$ _____
- Overtime labor \$ _____
- DO \$ _____

END OF SECTION

SECTION 210517

SLEEVES AND SLEEVE SEALS FOR FIRE PROTECTION PIPING

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. Sleeves.
- 2. Stack-sleeve fittings.
- 3. Sleeve-seal systems.
- 4. Sleeve-seal fittings.
- 5. Grout.
- 6. Silicone Sealants

B. Related requirements:

- 1. Section 078413 "Penetration Fire-Stopping" for penetration fire-stopping installed in fire-resistance-rated walls, horizontal assemblies and smoke barriers, with and without penetrating items.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:

- 1. Product Data: For sealants, indicating VOC content.
- 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. Metraflex Company (The).
 4. Pipeline Seal and Insulator, Inc.
 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. GPT; an EnPro Industries Company.
 4. Metraflex Company (The).
 5. Proco Products, Inc.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials, Inc.
 - c. Polymeric Systems, Inc.
 - d. Schnee-Morehead, Inc., an ITW Company.
 - e. Sherwin-Williams Company (The).
 - 2. Sealant shall have VOC content of 250 g/L or less.
 - 3. Sealant shall comply with the testing and product requirements of the California Department of Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - 2. Sealant shall have a VOC content of 250 g/L or less.
 - 3. Sealant shall comply with the California Department of Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".

- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Smooth-On.
 - 2. Sealant shall have a VOC content of 250 g/L or less.
 - 3. Sealant shall comply with the California Department of Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1" annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/2-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- E. Fire-Resistance Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Resistance Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration,

assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete wall or slab.
- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After following for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeves seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150) Steel Pipe Sleeves or Sleeve Seal Fittings.
 - b. Piping NPS 6 (DN 150) and Larger: Sleeve-Seal Fittings.
 - 2. Exterior Concrete Walls Below Grade:
 - a. Piping Smaller Than NPS 6 (DN 150) Steel pipe sleeves with sleeve-seal system or sleeve-seal fittings.

- 1) Select sleeve size to allow for 1-inch (25mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-Iron pipe sleeves with sleeve-seal system or steel pipe with sleeve-seal system
 - 1) Select sleeve size to allow for 1-inch (25mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves with sleeve-seal system or sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch (25mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system or steel pipe sleeves with sleeve-seal system or sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch (25 mm) annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs Above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves, PVC pipe sleeves, stack-sleeve fittings, sleeve-seal fittings or molded-PE or PP sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Steel pipe sleeves, PVC pipe sleeves, or stack-sleeve fittings.
5. Interior Partitions:
 - a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves or PVC pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel sheet sleeves.

END OF SECTION

SECTION 210518

ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

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. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Dearborn Brass.
 - 3. Jones Stephens Corp.
 - 4. Keeney Manufacturing Company (The)
 - 5. Mid-America Fittings, Inc.
 - 6. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.3 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
2. Escutcheons for Existing Piping:
- a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.
 - i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 210523

GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

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. Two-piece ball valves with indicators.
 - 2. Bronze butterfly valves with indicators.
 - 3. Iron butterfly valves with indicators.
 - 4. Check valves.
 - 5. Bronze OS&Y gate valves.
 - 6. Iron OS&Y gate valves.
 - 7. NRS gate valves.
 - 8. Indicator posts.
 - 9. Trim and drain valves.

1.3 DEFINITIONS

- A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
 - 1. Main Level: HAMV - Fire Main Equipment.
 - a. Level 1: HCBZ - Indicator Posts, Gate Valve.
 - b. Level 1: HLOT - Valves.
 - 1) Level 3: HLUG - Ball Valves, System Control.
 - 2) Level 3: HLXS - Butterfly Valves.
 - 3) Level 3: HMER - Check Valves.

- 4) Level 3: HMRZ - Gate Valves.
2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
 - a. Level 1: VQGU - Valves, Trim and Drain.
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
 1. Automated Sprinkler Systems:
 - a. Indicator posts.
 - b. Valves.
 - 1) Gate valves.
 - 2) Check valves.
 - a) Single check valves.
 - 3) Miscellaneous valves.
- C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- D. ASME Compliance:
 1. ASME B16.1 for flanges on iron valves.
 2. ASME B1.20.1 for threads for threaded-end valves.
 3. ASME B31.9 for building services piping valves.
- E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- F. NFPA Compliance: Comply with NFPA 24 for valves.
- G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 (DN 50) and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. NIBCO INC.
2. Victaulic Company.

- B. Description:

1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear or traveling nut.
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
12. End Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fivalco Inc.
2. Globe Fire Sprinkler Corporation.
3. Milwaukee Valve Company.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig (1200 kPa).
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: [Stainless steel][with EPDM coating].
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
10. Ends Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International.
2. Fivalco Inc.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve Company; a division of McWane, Inc.
5. NIBCO INC.
6. Tyco Fire & Building Products LP.
7. Victaulic Company.
8. Zurn Industries, LLC.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Material: Cast or ductile iron[with nylon, EPDM, epoxy, or polyamide coating].
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, [nickel plated] [and EPDM or SBR coated].
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.

9. Body Design: Lug or wafer.

2.5 CHECK VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International.
2. Fire Protection Products, Inc.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve Company; a division of McWane, Inc.
5. Mueller Co.
6. NIBCO INC.
7. Reliable Automatic Sprinkler Co., Inc. (The).
8. Tyco Fire & Building Products LP.
9. United Brass Works, Inc.
10. Victaulic Company.

- B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Milwaukee Valve Company.
2. NIBCO INC.
3. United Brass Works, Inc.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Hammond Valve.
4. Kennedy Valve Company; a division of McWane, Inc.
5. Mueller Co.
6. NIBCO INC.
7. Victaulic Company.
8. Watts; a Watts Water Technologies company.
9. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronz[with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.

9. End Connections: Flanged Grooved.

2.8 NRS GATE VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Kennedy Valve Company; a division of McWane, Inc.
4. Mueller Co.
5. NIBCO INC.
6. Victaulic Company.
7. Zurn Industries, LLC.

- B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged Grooved.

2.9 INDICATOR POSTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Kennedy Valve Company; a division of McWane, Inc.
4. Mueller Co.

B. Description:

1. Standard: UL 789 and FM Global standard for indicator posts.
2. Type: Underground.
3. Base Barrel Material: Cast or ductile iron.
4. Extension Barrel: Cast or ductile iron.
5. Cap: Cast or ductile iron.
6. Operation: Wrench]

2.10 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Fire Protection Products, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Flowserve Corporation.
 - e. FNW; Ferguson Enterprises, Inc.
 - f. KITZ Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Potter Roemer LLC.
 - j. Red-White Valve Corporation.
 - k. Tyco Fire & Building Products LP.
2. Description:
 - a. Pressure Rating: psig (2070 kPa).
 - b. Body Design: Two piece.
 - c. Body Material: Forged brass or bronze.
 - d. Port size: Full or standard.
 - e. Seats: PTFE.
 - f. Stem: Bronze or stainless steel.
 - g. Ball: Chrome-plated brass.
 - h. Actuator: Handlever.

- i. End Connections for Valves NPS 1 (DN 25) through NPS 2-1/2 (DN 65): Threaded ends.
- j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2 (DN 32 and DN 65): Grooved ends.

B. Angle Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire Protection Products, Inc.
 - b. NIBCO INC.
 - c. United Brass Works, Inc.
- 2. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Brass or bronze.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. United Brass Works, Inc.
- 2. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Bronze with integral seat and screw-in bonnet.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc Holder and Nut: Bronze.
 - f. Disc Seat: Nitrile.

- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

- A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
 - 1. Section 211200 "Fire-Suppression Standpipes" for application of valves in fire-suppression standpipes. All standpipe valves and fittings should be 300 psig WWP minimum.
 - 2. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
 - 3. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems. All sprinkler valves and fittings should be 175 psig WWP minimum.

- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.
- H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
- I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION

SECTION 210800

COMMISSIONING OF FIRE-SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. This Section includes general requirements that apply to implementation of the commissioning process to the fire-suppression systems, assemblies, and components.
- B. Related Sections include the following:
 - 1. Division 01 Section 019113 General Commissioning Requirements for general commissioning process activities.
 - 2. Division 01 Section 013300 "Submittal Procedures" for submitting procedures.
 - 3. Division 01 Section 017823 "Operation and Maintenance Data" for the operation and maintenance data.
 - 4. Division 01 Section 017900 "Demonstration and Training" for training and demonstration requirements.
 - 5. Division 21 Fire-Suppression
 - 6. Division 28 Electronic Safety and Security for fire alarm interaction and requirements.

1.3 DEFINITIONS

- A. Commissioning Plan: A document, prepared by CxA, that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

- B. CxA: Commissioning Authority.
- C. Quality Assurance: A program for the systematic monitoring and evaluation of the various aspects of a system, assembly, or component to ensure that standards of quality are being met. This is the responsibility of the CxA.
- D. Quality Control: A system for ensuring the maintenance of proper standards in systems, assemblies, and components. This is the responsibility of the Contractor.
- E. Official: State or Local official having jurisdiction over conveying systems.
- F. Systems, Assemblies, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, equipment, and components.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. The CxA shall provide Construction Checklists to the Contractors for execution that will indicate expected Quality Control features required for a highest-quality installation. The contractor shall complete the checklists as construction progresses and return them to the CxA as indicated in Section 01 9113 General Commissioning Requirements.
- B. Checklists for this section will include:
 - 1. Standpipe and sprinkler systems.
 - 2. Fire pump and controller.
 - 3. All Piping and Ancillary Hardware.
- C. A sample installation checklist is included to show the typical scope and rigor of the process.

3.2 PREREQUISITES TO TESTING

- A. Prior to the testing of these systems or assemblies, the Contractor shall certify that:
1. The system or assembly is completely installed, functional, and documented.
 2. Work performed by other trades, but essential for this system or assembly's operation, is complete (e.g., electrical components are wired and power is provided).
 3. All contractor-performed start-up procedures and Pre-Functional Tests are complete and documented.
 4. The system or assembly is ready for the Owner to take beneficial use.

3.3 SYSTEM OR ASSEMBLY TEST REQUIREMENTS

- A. The CxA will provide Functional Performance Test procedures to the Contractor for execution for the following specific systems, assemblies and components:
1. Standpipe and sprinkler systems.
 2. Fire pump and controller.
 3. Fire alarm system interactions.
- B. Acceptance criteria and test details will be in accordance with the related sections including the following:
1. Division 01 Section 019113 General Commissioning Requirements for general commissioning process activities.
 2. Division 21 – Fire-Suppression.
 3. Division 28 Electronic Safety and Security.
 4. Division 01 Section 017823 “Operation and Maintenance Data” for the operation and maintenance data.
 5. Division 01 Section 017900 “Demonstration and Training” for training and demonstration requirements.
- C. A sample functional performance test is included to show the typical scope and rigor of the process.

3.4 TEST REPORTS

- A. Provide copies of all reports required in the listed reference sections (see Section 1.2 SUMMARY above for the sections) for review.

3.5 SAMPLE FORMS

**SAMPLE
 Installation Checklist
 Sprinkler Piping – Second Floor**

Schedule ID# from drawings:

Reference Specification:

Reference Drawing:

Location:

Model Verification

	Specified	Submitted	Installed
Manufacturer			
Model Number			
Pumps: QTY/HP			
Capacity			
Voltage/Ph			

Installation Checks

ID	Description	Pass/Fail	Comments
1	Verify sprinkler piping is run level.	<input type="checkbox"/> <input type="checkbox"/>	
2	Verify sprinkler piping is schedule 40 black steel piping and has been provided with the appropriate fittings: a. Piping 1" to 2" Threaded Fittings. b. Piping 2½" and greater-Victaulic Fittings.	<input type="checkbox"/> <input type="checkbox"/>	
3	Verify piping has been properly supported.	<input type="checkbox"/> <input type="checkbox"/>	

4	Verify that the "Wet" system piping is not run in MDF Room or Electrical Room.	<input type="checkbox"/> <input type="checkbox"/>	
5	Verify that standpipe and hose valve cabinets are installed at each stair landing at 48" A.F.F.	<input type="checkbox"/> <input type="checkbox"/>	
6	Verify that floor zone control valve assembly and drain piping have been installed in Stair #X.	<input type="checkbox"/> <input type="checkbox"/>	
7	Verify piping has been provided with seismic bracing where required.	<input type="checkbox"/> <input type="checkbox"/>	
8	Verify that auxiliary drains have been provided for all trapped piping.	<input type="checkbox"/> <input type="checkbox"/>	
9	Verify piping has been clearly identified with proper color coding.	<input type="checkbox"/> <input type="checkbox"/>	

Approvals (Only One Required)

	Name (Printed Neatly)	Signature	Date
Contractor/Manuf. Rep.			
Engineer			
Construction Administrator			
Commissioning Agent			

**Sample Functional Performance Test
 Domestic Hot Water Heaters**

1. Participants

Name/Representing	Participation (Testing, Witness, etc.)
/	

/	
/	
/	Owner's Representative

Party filling out this form _____ Date of Test _____

2. Prerequisite Checklist

- (Y / N) An "as-built" version of the controls submittal has been provided.
- (Y / N) A startup service report has been provided by a factory-authorized service representative.
- (Y / N) The controls contractor has certified that their internal commissioning is complete and the project is ready for third-party verification.
 CC initials: _____ Date: _____
- (Y / N) The general contractor has certified that the construction is substantially complete and ready for third-party verification.
 GC initials: _____ Date: _____
- (Y / N) Record all values for set points, control parameters, limits, delays, lockouts, schedules, etc., that were changed to accommodate testing:

Parameter	Pre-Test Values	Returned to Pre-Test Values <input checked="" type="checkbox"/>
Fire Pump Status		<input type="checkbox"/>
Fire Pump Inlet Valve Status		<input type="checkbox"/>
Fire Pump Inlet Discharge Valve #1 Status		<input type="checkbox"/>
Fire Pump Discharge Valve #2 Status		<input type="checkbox"/>

Parameter	Pre-Test Values	Returned to Pre-Test Values <input checked="" type="checkbox"/>
Jockey Pump Status		<input type="checkbox"/>
Jockey Pump Inlet Side Valve Status		<input type="checkbox"/>
Wet Alarm Check Valve Status		<input type="checkbox"/>
Fire Pump Test Header Valve Status		<input type="checkbox"/>

Fire Pump Bypass Line Valve #1 Status		<input type="checkbox"/>	Fire Dept. Connection Valve Status		<input type="checkbox"/>
Fire Pump Bypass Line Valve #2 Status		<input type="checkbox"/>	Low Pressure Alarm		<input type="checkbox"/>

3. Sensor Calibration Checks. The sensors listed below are to be checked for calibration and adequate location.

Sensor	Location OK ¹	BAS Value	Measured Value	Pass Y/N
	Y/N			Y/N
	Y/N			Y/N
	Y/N			Y/N
	Y/N			Y/N

Sensor	Location OK ¹	BAS Value	Measured Value	Pass Y/N
	Y/N			Y/N
	Y/N			Y/N
	Y/N			Y/N
	Y/N			Y/N

¹Senor location is appropriate and away from causes of erratic operation.

Comments:

4. Device Calibration Checks. The actuators or devices listed below are to be checked for proper operation and/or calibration.

Device or Actuator	Procedure / State	BAS Value	Site Observation	Pass (Y/N)
Fire Pump Inlet Valve Status	1. On			Y/N
	2. Off			Y/N
Fire Pump Discharge Valve #1 Tamper Switch Status	1. Alarm			Y/N
	2. Normal			Y/N
Fire Pump Discharge Valve #2 Tamper Switch Status	1. Open			Y/N
	2. Closed			Y/N

Fire Pump Bypass Line Valve #1 Tamper Switch Status	1.	Open			Y / N
	2.	Closed			Y / N
Fire Pump Bypass Line Valve #2 Tamper Switch Status	1.	Open			Y / N
	2.	Closed			Y / N
Jockey Pump Inlet Side Valve Tamper Switch Status	1.	Open			Y / N
	2.	Closed			Y / N
Fire Pump Test Header Valve Tamper Switch Status	1.	Open			Y / N
	2.	Closed			Y / N
Fire Dept. Connection Valve Tamper Switch Status	1.	Open			Y / N
	2.	Closed			Y / N

5. Notes:

6. Functional Testing Record

Seq. ID	Mode ID	Test Procedure (including special conditions)	Expected Response	Pass (Y / N)	Notes
1	JOCKEY PUMP AUTOMATIC	1. With jockey pump in "AUTO" position, lower	1. The jockey pump will start when the system pressure reaches the	Y / N	

	START	<p>sprinkler pressure by opening system drain valve.</p> <ol style="list-style-type: none"> Close system drain valve. 	<p>pre-set turn on setting.</p> <ol style="list-style-type: none"> The pump runs until the system pressure reaches the shutoff setting, at which time the jockey pump will stop. 		
2	FIRE PUMP AUTOMATIC START	<ol style="list-style-type: none"> With the jockey pump in the "ON" position, open the "Alarm Test Module" valve to reduce system pressure. Close the "Alarm Test Module" valve. 	<ol style="list-style-type: none"> The Fire Pump will start when the system pressure reaches the pre-set fire pump "start" setting. The system returns to the proper pressure. The fire pump runs for a predetermined time and shuts off at the end of that time period. 	Y / N	
3	FIRE PUMP RUNNING ON EMERGENCY GENERATOR	<ol style="list-style-type: none"> If equipped, activate the Emergency Generator "RUN" switch. With the emergency generator running and the jockey pump switch in the "OFF" position, reduce the pressure in the sprinkler system by opening the Alarm Test Module valve. Close test valve. Return generator switch to "NORMAL" position. 	<ol style="list-style-type: none"> Emergency generator starts. Fire pump is now fed from generator. Fire pump runs. Fire pump turns off after a predetermined time period. Fire pump power is fed from normal power and Emer. Generator shuts off. 	Y / N	

-- END OF TEST --

END OF SECTION

SECTION 211313

WET-PIPE SPRINKLER SYSTEMS

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. Pipes, fittings, and specialties.
 - 2. Cover system for sprinkler piping.
 - 3. Specialty valves.
 - 4. Sprinklers.
 - 5. Alarm devices.
 - 6. Manual control stations.
 - 7. Control panels.
 - 8. Pressure gages.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
 2. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Domestic water piping.
 2. Compressed air piping.
 3. HVAC hydronic piping.
 4. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Fire alarm devices.
 - e. Projectors.
- B. Qualification Data: For qualified Installer and professional engineer.
- C. Design Data:
1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Field Test Reports:
1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 2. Fire-hydrant flow test report.
- F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

1.9 FIELD CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify Architect Construction Manager and Owner no fewer than one week in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13.
- B. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.
- C. High-Pressure Piping System Component: Listed for [250-psig (1725-kPa) minimum] [300-psig (2070-kPa)] working pressure.
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and [ASCE/SEI 7].

2.2 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Galvanized-and Black- Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 40, Galvanized and Black-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E ; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 40 and not more than Schedule 80. Pipe ends may be factory or field formed to match joining method.
- C. Galvanized-and Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Galvanized-and Uncoated-steel Couplings: ASTM A 865/A 865M, threaded.
- E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - 1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.

- a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anvil International.
 - b. Shurjoint Piping Products USA, Inc.
 - c. Victaulic Company.
 2. Pressure Rating: 175-psig minimum.
 3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
 - a. Rigid grooved couplings (1-1/4" through 12"):
 - i. "installation ready" rigid joints shall be victaulic firelock® ez style 009n or 109 [culus, fm]. Designed for direct "stab" installation onto grooved pipe without prior disassembly of the coupling.
 - ii. Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with nfpa 13.
 - iii. Rigid couplings shall require visual pad-to-pad verification of complete installation. Tongue and recess type couplings which require the use of a torque wrench to achieve the exact required gap between housings are not permitted.
 - b. Rigid grooved couplings (1")
 - i. Pipe: in lieu of threaded steel piping systems, the victaulic firelock igs system with "installation-ready™ fittings and couplings may be used for nps 1 (dn 25) schedule 10 and schedule 40 carbon steel pipe in fire protection applications. System rated for a working pressure to 365 psi (2517 kpa). Victaulic style 101 (90-degree elbow), style 102 (tee), and style 108 (coupling) with installation-ready™ ends.
 - c. Grooved fittings

- i. Installation-ready™ fittings for grooved end steel piping in fire protection applications sizes nps 1-¼ thru 2½ (dn 32 thru dn 65). Fittings shall consist of a ductile iron housing conforming to astm a-536, grade 65-45-12, with installation-ready™ ends, [orange enamel coated] [red enamel coated] [galvanized]. Fittings complete with prelubricated grade “e” epdm type 'a' gasket; and astm a449 electroplated steel bolts and nuts. System shall be ul listed for a working pressure of 300 psi (2065 kpa) and fm approved for working pressure 365 psi (2517kpa).
 - ii. Or victaulic grooved end fittings: fittings shall be cast of ductile iron conforming to astm a-536, grade 65-45-12 (firelock®), forged steel conforming to astm a-234, grade
4. Galvanized painted Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.

2.3 COVER SYSTEM FOR SPRINKLER PIPING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. DecoShield Systems, Inc.
- B. Description: System of support brackets and covers made to protect sprinkler piping.
- C. Brackets: Glass-reinforced nylon.
- D. Covers: Extruded-PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.4 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 1. High-Pressure Piping Specialty Valves: 300 psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.

F. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco Fire Products LP.
 - d. Venus Fire Protection Ltd.
 - e. Victaulic Company.
 - f. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, [retarding chamber,] and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
7. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Deluge Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. BERMAD Control Valves.
 - b. CLA-VAL Automatic Control Valves.
 - c. Globe Fire Sprinkler Corporation.
 - d. Kidde Fire Fighting; A UTC Business Unit.
 - e. OCV Control Valves.
 - f. Reliable Automatic Sprinkler Co., Inc. (The).
 - g. Tyco Fire Products LP.
 - h. Venus Fire Protection Ltd.
 - i. Victaulic Company.
 - j. Viking Corporation.
2. Standard: UL 260.
3. Design: Hydraulically operated, differential-pressure type.

4. Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.
5. Wet, Pilot-Line Trim Set: Include gage to read diaphragm-chamber pressure and manual control station for manual operation of deluge valve, and connection for actuation device.

H. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175-psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.5 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anvil International.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products USA, Inc.
 - d. Tyco Fire Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 300 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AGF Manufacturing, Inc.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco Fire Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 300 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer LLC.
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AGF Manufacturing, Inc.
 - b. Triple R Specialty.

- c. Tyco Fire Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 3. Pressure Rating: 300 psig minimum.
 4. Body Material: Cast- or ductile-iron housing with sight glass.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Aegis Technologies, Inc.
 - b. CECA, LLC.
 - c. Corcoran Piping System Co.
 - d. Merit Manufacturing.
 2. Standard: UL 1474.
 3. Pressure Rating: 250-psig minimum.
 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 5. Size: Same as connected piping.
 6. Length: Adjustable.
 7. Inlet and Outlet: Threaded.
- F. Flexible Sprinkler Hose Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. FlexHead Industries, Inc.
 - b. Victaulic Company.
 2. Standard: UL 1474.
 3. Pressure Rating: 175-psig minimum.
 4. Size: Same as connected piping, for sprinkler.
 5. Multiple-use flexible drop system: Shall be Victaulic viciflex multiple-use flexible stainless steel sprinkler drop system, shall be fin & ul approved style ah2 or ah2cc and may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel 1" victaulic firelock igs groove style 108 coupling for connection to branch-line

piping, and a zinc plated steel reducer with a 1/2" or 3/4" npt female thread for connection to the sprinkler head.

2.6 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Globe Fire Sprinkler Corporation.
 2. Reliable Automatic Sprinkler Co., Inc. (The).
 3. Tyco Fire Products LP.
 4. Venus Fire Protection Ltd.
 5. Victaulic Company.
 6. Viking Corporation.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Residential Sprinklers: 175-psig maximum.
- D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- E. Pressure Rating for High-Pressure Automatic Sprinklers: [250-psig (1725-kPa) minimum] [300 psig (2070 kPa)].
- F. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.7 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Tyco Fire Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 8-1/2-inches (216-mm) diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4 (DN 20).
8. Outlet: NPS 1 (DN 25) drain connection.

C. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Notifier.
 - c. Potter Electric Signal Company, LLC.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: [6-inch (150-mm) minimum-] [8-inch (200-mm) minimum-] [10-inch (250-mm)] diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. ADT Security Services, Inc.
 - b. McDonnell & Miller.
 - c. Potter Electric Signal Company, LLC.
 - d. System Sensor.
 - e. Viking Corporation.
 - f. Watts; a Watts Water Technologies company.
2. Standard: UL 346.
 3. Water-Flow Detector: Electrically supervised.
 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 5. Type: Paddle operated.
 6. Pressure Rating: 250 psig (1725 kPa).
 7. Design Installation: Horizontal or vertical.

E. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Barksdale, Inc.
 - b. Detroit Switch, Inc.
 - c. Potter Electric Signal Company, LLC.
 - d. System Sensor.
 - e. Tyco Fire Products LP.
 - f. United Electric Controls Co.
 - g. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

F. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Kennedy Valve Company; a division of McWane, Inc.

- c. Potter Electric Signal Company, LLC.
 - d. System Sensor.
2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled valve is in other than fully open position.
 6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.8 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve.
- B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.9 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type I enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
 1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
 2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- C. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- D. Panels Components:

1. Power supply.
2. Battery charger.
3. Standby batteries.
4. Field-wiring terminal strip.
5. Electrically supervised solenoid valves and polarized fire-alarm bell.
6. Lamp test facility.
7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

2.10 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. AGF Manufacturing, Inc.
 2. AMETEK, Inc.
 3. Ashcroft Inc.
 4. Brecco Corporation.
 5. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: [0- to 250-psig (0- to 1725-kPa) minimum] [0 to 300 psig (0 to 2070 kPa)].
- E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.
- N. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices or air compressors.
- O. Fill sprinkler system piping with water.
- P. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- O. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- P. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- Q. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2104. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- R. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- S. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

3.7 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
 - 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.8 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.11 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.13 PIPING SCHEDULE (SPEC WRITER EDIT FOR SPECIFIC PROJECT)

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with [threaded ends, cast-iron threaded fittings, and threaded] [grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved] joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

- C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. CPVC pipe, [Schedule 40] [Schedule 80] CPVC fittings, and solvent-cemented joints may be used for light-hazard and residential occupancies.
- E. Standard-pressure, wet-pipe sprinkler system, [NPS 2 (DN 50) and smaller] <Insert pipe size range>, shall be [one of] the following:
1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Standard-weight or Schedule 30, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
 4. Standard-weight or Schedule 30, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
 5. Standard-weight or Schedule 30, black-steel pipe with [cut-] [or] [roll-]grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 6. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 7. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 8. Thinwall, Schedule 10, nonstandard OD, thinwall or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 9. Thinwall, Schedule 10 or hybrid black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
 10. Thinwall, Schedule 10, nonstandard OD, thinwall or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
 11. Schedule 5 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.
 12. [Type L (Type B)] [Type M (Type C)], hard copper tube with plain ends; [cast-] [or] [wrought-]copper, solder-joint fittings; and brazed joints.
 13. [Type L (Type B)] [Type M (Type C)], hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
 14. NPS 2 (DN 50), [Type L (Type B)] [Type M (Type C)], hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
- F. Standard-pressure, wet-pipe sprinkler system, [NPS 2-1/2 to NPS 4 (DN 65 to DN 100)] <Insert pipe size range>, shall be [one of] the following:

1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Standard-weight or Schedule 30, black-steel pipe with [cut-] [or] [roll-]grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 5. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 6. Thinwall, Schedule 10, nonstandard OD, thinwall or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 7. Thinwall, Schedule 10, nonstandard OD, thinwall or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.
 8. [Type L (Type B)] [Type M (Type C)], hard copper tube with plain ends; [cast-] [or] [wrought-]copper, solder-joint fittings; and brazed joints.
 9. [Type L (Type B)] [Type M (Type C)], hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
 10. [Type L (Type B)] [Type M (Type C)], hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
- G. Standard-pressure, wet-pipe sprinkler system, [NPS 5 (DN 125) and larger] <Insert pipe size range>, shall be[one of] the following:
1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Standard-weight or Schedule 30, black-steel pipe with [cut-] [or] [roll-]grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 5. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
 6. Thinwall, Schedule 10 or hybrid black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 7. Thinwall, Schedule 10 or hybrid black-steel pipe with plain ends; welding fittings; and welded joints.

8. [Type L (Type B)] [Type M (Type C)], hard copper tube with plain ends; [cast-] [or] [wrought-]copper, solder-joint fittings; and brazed joints.
9. [Type L (Type B)] [Type M (Type C)], hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

3.14 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated on drawings.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated on drawings.
5. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.
6. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated on drawings.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Residential Sprinklers: Dull chrome.
5. Upright, Pendent or Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SPECIFICATIONS GROUP

Facility Services Subgroup

DIVISION 22 - PLUMBING

Division	Section Title
220500	BASIC PLUMBING REQUIREMENTS
220517	SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING
220518	ESCUTCHEONS FOR PLUMBING PIPING
220519	METERS AND GAGES FOR PLUMBING PIPING
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220700	PLUMBING INSULATION
220800	COMMISSIONING OF PLUMBING SYSTEMS
221116	DOMESTIC WATER PIPING
221119	DOMESTIC WATER PIPING SPECIALTIES
221316	SANITARY, STORM, WASTE AND VENT PIPING
221319	SANITARY WASTE PIPING SPECIALTIES
221329.1	SUMP PUMPS

END OF TABLE OF CONTENTS

SECTION 220500

BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes general administrative and procedural requirements for plumbing installations.
- B. This section is part of each Division 22 Section.

1.2 DEFINITIONS AND INTERPRETATIONS

- A. Definitions:
 - 1. This section assumes that a Construction Manager is reporting directly to the Owner and is authorized to act on behalf of the Owner as called out. In any situation where a CM is not a part of the project, all responsibilities called to be by the CM will be performed by the General Contractor reporting directly to the Owner.
 - a. For purposes of these Specifications the following definitions apply:
 - b. "Engineer" - the Engineer of record.
 - c. "Provide" - to "furnish" and "install."
 - d. "Install" - to receive; handle; rig; set in place; join; unite; fasten; link; attach; set up or otherwise connect together; complete, tested and ready for normal satisfactory operation including all labor inclusive of start-up and commissioning.
 - e. "Furnish" - to supply all materials, equipment, testing apparatus, controls, tests, commissioning, accessories, warranty and all other items customarily required for the proper and complete application.
 - f. "As directed" - as directed by the Architect or the Engineer.

- g. "Concealed" - embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings (including accessible ceilings)
- h. "Exposed" - not concealed (visible without removal of wall or ceiling)
- i. "Submit" - submit to the Architect and/or the Engineer for review.
- j. "By Other Trades" or "Others" or "Oth"-----By persons or parties responsible for work at the project other than the party or parties who have been duly awarded the contract for the work of this trade. In the event that this document is used to acquire work as part of a general construction contract the words "by other trades" shall mean by persons or parties who are not anticipated to be the sub-contractor for this trade working together with the general contractor. In this context the words "by other trades" shall not be interpreted to mean not included in the overall contract.
- k. Where reference is made to "N.E.M.A. Standards," it shall be understood that this reference is to the "approved Standards," published by the National Electrical Manufacturers Association, Main Office-155 East 44th Street, New York, NY 10017.
- l. Where reference is made to "A.N.S.I. Standards", it shall be understood that this reference is to the standards published by the American National Standards Institute Incorporated.
- m. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- n. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.
- o. No exclusions from, or limitations, in the language used in the drawings or specifications shall be interpreted as meaning that the appurtenances or accessories necessary to complete any required system or item of equipment are to be omitted.
- p. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Work shown on all drawings including floor plans, riser diagrams, schedules and details is the responsibility of the contractor regardless of

conflicts and coordination. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance mechanical drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings.

- q. No interpretations shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- r. Certain details appear on the drawings, which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
- s. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
- t. The use of words in the singular shall not be considered as limiting where other indications denote that more than one items is referred to.

B. Abbreviations:

- 1. For purposes of these Specifications the following abbreviations apply:

AABC	American Association of Balancing Contractors
ABMA	American Boiler Manufacturers Association
ADC	Air Diffusion Council
AGA	American Gas Association
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers

ASSE	American Society of Sanitary Engineers
AWWA	American Water Works Association
AWS	American Welding Society
BMS	Building Control System
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CTI	Cooling Tower Institute
EPA	Environmental Protection Agency
ETL	Electric Testing Laboratory
FM	Factory Mutual (Global)
FS	Federal Specifications
IEEE	Institute of Electrical and Electronic Engineers
IRI	Industrial Risk Insurers
MCAA	Mechanical Contractors Association of America
MSDS	Materials Safety Data Sheet
MSS	Manufacturer's Standardization Society Standards
NAPHCC	National Association of Plumbing Heating and Cooling Contractors
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code (NFPA 70)
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety Health Administration
PDI	Plumbing and Drainage Institute

SAE	Society of Automotive Engineers
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
TEMA	Tubular Exchangers Manufacturers Association
UL	Underwriter Laboratories
UPS	Uninterruptible Power System
USGBC	United States Green Building Council

1.3 RELATED DOCUMENTS

- A. Submittals Section 013300
- B. Construction Waste Management Section 017419
- C. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and other sections of Division 23.
- D. Commissioning of Mechanical Services Section 230800
- E. Commissioning of Plumbing Systems Section 220800

1.4 QUALITY CONTROL

- A. Comply with current governing codes, ordinances and regulations, as well as with requirements of EPA, U.L. and all other applicable codes.
- B. Comply with the requirements of agencies or authorities having jurisdiction over any part of the work and secure all necessary permits.
- C. Where codes or standards are listed herein, the applicable portions apply.
- D. Plans, specifications, codes and standards are minimum requirements. Where requirements differ, apply the more stringent.
- E. Should any change in plans or specifications be required to comply with governing regulations, notify the Architect/Engineer at the time of submitting this bid.

- F. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workmanlike manner by competent workmen. Provide a competent, experienced full-time superintendent who is authorized to make decisions on behalf of the contractor.
- G. All equipment and material to be furnished and installed on this Project shall be UL, ETL or any other recognized agency listed, and be suitable for its intended use in this project in accordance with the requirements of the City, state or any other Authority having jurisdiction.

1.5 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

- A. Air -conditioning and Refrigeration Institute (ARI).
- B. American National Standard Institute (ANSI).
- C. Air Moving and Conditioning Association (AMCA).
- D. American Society of Mechanical Engineers (ASME).
- E. American Society of Plumbing Engineers (ASPE).
- F. American Society for Testing and Materials (ASTM).
- G. National Fire Protection Association (NFPA).
- H. National Electrical Manufacturers Association (NEMA).
- I. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
- J. American Welding Society (AWS).
- K. Cast Iron Soil Pipe Institute (CISPI).
- L. Electrical Testing Laboratories (ETL).
- M. Environmental Protection Agency (EPA).
- N. Manufacturers' Standardization Society Standards (MSS).
- O. National Electrical Code (NEC).

- P. Occupational Safety and Health Administration (OSHA).
- Q. Underwriters Laboratories (UL).

1.6 PROPOSALS AND ALTERNATES

- A. See the Contractor's and/or Owner's "Instructions to Bidders" for Allowances, Unit Prices and Alternates.
- B. Compliance Reviews: The contractor and equipment vendor shall provide a Compliance Review with the bid proposal of the applicable Drawings, Specifications and Addenda and for all equipment and alternates listed hereinafter for this Project. The Compliance Review will be paragraph-by-paragraph review of the Specifications with the following information, "C","D","E" or "N/A," marked for each Specification section paragraph in the margin of the Specification and any subsequent Addenda.
 - 1. "C": Comply with no exceptions.
 - 2. "D": Comply with minor deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 - 3. "E": Exception. Equipment, product or material does not comply. For each and every exception, provide a numbered footnote with reasons for the exception for the Owner's consideration and possible alternatives.
 - 4. "N/A": The specification paragraph does not apply to the proposed equipment, material or product.
 - 5. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the equipment proposed for this project is in complete compliance with the Contract Documents. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradictions do not release the Contractor from being in complete compliance, unless the exception or deviation has been specifically noted (explicitly, not by implication) in the Compliance Review.
- C. Equipment Alternatives:
 - 1. Request for Substitution - Contractor initiated change to specified equipment or system for which the Owner/Architect/Engineer reserve the right to reject without review. Requests for Substitution must comply with the following:

- a. Submit proposals to supply substitute materials or equipment, in writing, to the Construction Manager. Include the following information with the proposal:
 - 1) A description of the difference between the contract document requirements and that proposed listing the comparative features of each, including operating cost impact and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of implementation costs.
 - 2) A list of the contract requirements that must be revised if the substitution is accepted, including any suggested specification revisions. Include a description and estimate of costs the Engineer of record may incur in implementing the proposed substitution.
 - 3) Include a description and estimate of costs the Owner may incur in implementing the change, such as test, evaluation, operating and support costs.
 - 4) A projection of any effects the proposed change would have on collateral costs to the Owner.
 - 5) A statement of any effect on the contract completion time or the delivery schedule.
 - 6) A statement indicating the reduction to the contract price if the Owner accepts the change. Be responsible for appropriate modifications to all trades.
2. Include all revisions required to adapt substitutions in such proposals, including revisions by other trades. Only substitutions that reflect equal quality with a lower contract price and/or decreased operating costs will be considered.
3. Wherever operating results such as quantity delivered or pressure obtained are scheduled, or when the make and size of apparatus, for which such quantities are readily determinable, is specified, the substitution being proposed must conform substantially to the quantities specified or implied. The substitution must fit into available space conditions and must function properly in coordination with the rest of the system.

1.7 DRAWINGS

- A. The Drawings show the general layout of the various items of equipment. However, layout of equipment, accessories, specialties, etc., are diagrammatic unless specifically dimensioned and do not necessarily indicate every required fitting, support or similar items required for a complete installation. Consult the Architectural Drawings and details for exact locations of fixtures and equipment. Where same is not definitively located, obtain the information from the Architect before proceeding. Any reasonable changes in locations indicated shall be made by the Contractor without additional cost to the Owner, if such changes are ordered prior to performance of the affected Work.

- B. The Contractor shall follow the Drawings in laying out the Work and check Drawings of all trades to verify spaces in which Work will be installed. Maintain maximum headroom and where space conditions appear inadequate; the Architect shall be notified before proceeding with the installation.
- C. Equipment shown on the Drawings has been coordinated for structural penetrations, electrical connection, operating and service (maintenance) requirements and physical size with regard to the space where the equipment is shown. If they comply with the Specifications, these and the other specified manufacturers of this equipment will be acceptable contingent on the Contractor providing a complete installation and maintaining full responsibility to provide, at no additional cost, any modifications to the Architectural, Structural, Mechanical or Electrical Systems that are required to properly install, operate and service the equipment being used. These modifications shall not include additional area for equipment unless approved by the Architect.
 - 1. The Contractor shall note these changes on the equipment submittals and the Compliance Review and shall show all differences in equipment being supplied from that specified and shown on the Drawings. Failure of the Contractor to provide this information with the submittal will indicate the submitted equipment meets or exceeds the requirements of the equipment shown on the Drawings in performance and is physically no larger in housing size.
 - a. Failure of the Contractor to comply with the above and any discrepancies found should result in the Contractor providing equipment equal to that specified at the Contractor's expense.

1.8 SUBMITTALS

- A. General: The following information is required for review by the Owner, Architect and Engineer and is to be provided as it applies to this contract. It does not address items that may be required by the Construction Manager such as daily reports, minutes to safety meetings, etc.:
 - 1. Requisition Breakdown (include material quantities relative to each area, i.e., length of pipe or pounds of sheet metal)
 - 2. Unit Prices (prior to contract award)
 - 3. Wage Rate Breakdowns (prior to contract award)
 - 4. Projection Of Manpower Loading
 - 5. Statement of review and acceptance of project schedule and task durations
 - 6. Site Safety Plan

7. Submittal Log
8. Submittal Data as defined below
9. Drawing Plot Plan
10. Coordination Drawing Log
11. Proposed Sub-Contractors List
12. Equipment Manufacturers And Material Suppliers List
13. Requests for Substitution
14. Manufacturer's Compliance Reviews
15. Contractor Certification Forms
16. Manufacturer's Certification Forms
17. List of samples to be submitted
18. List of all permits to be provided.
19. List of all Engineers providing sign-offs, certifications, and Controlled Inspections
20. Sleeve and Slab Penetration Drawings
21. Details and locations of embeds
22. Equipment pad location and sizing drawings
23. Drawings showing point loading of equipment and hung supports in excess of 200 pounds
24. Pipe and Conduit Expansion Drawings And Calculations
25. List of items proposed to be ship fabricated along with skid details (Provide spool details on request.)
26. Shop Standards
27. Material Standards

28. Welding procedures and list of certified personnel with record of certification of steam piping is the responsibility of this contractor. (Submit copies of all reports and approvals on completion.)
29. Coordination Drawings
30. Testing procedures including deferred testing (seasonal or out of sequence based on maintaining job progress schedule)
31. Alignment Reports
32. Manufacturer's Factory Test Reports
33. Manufacturer's and Contractor's Start-Up Reports
34. All MSDS Forms for materials brought on site
35. List of all fuse sizes prior to start-up
36. Spare parts lists
37. O&M Manuals
38. Valve Tags List And Charts
39. As-Built Drawings
40. As-Built reflected ceiling and floor drawings showing access door locations indicating type and nature of concealed device
41. Manufacturer's standard warranty along with signed acknowledgement of modified terms per this contract
42. Contractor Warranty
43. Training Outlines and Agenda
44. Commissioning Pre-Functional Testing Forms
45. Commissioning Logs And Test Results
46. Certified Project Record Documents
47. Updated Equipment Schedule Sheets

48. Notice of completion
49. Where required: Submit the following according to the Conditions of the Contract and as specified in Division 1 Section 013300 - "Submittal Procedures".
 - B. The Division 22 Contractor shall submit a complete typed list of all mechanical equipment manufacturers and material suppliers for the equipment and materials they intend to furnish and install on this project for review by the Owner/Architect/Engineer prior to the award of the contract.
 - C. Each Contractor shall prepare an index of all Division 22 submittals for the Project. The index shall include a submittal identification number, a cross-reference to the Specification Section or Drawing number and an item description. The submittal identification number shall be prefixed by the applicable Specification Section. Each submittal shall bear the submittal identification number in addition to the other data specified. All consultants, the Owner and all Contractors will utilize the assigned submittal identification number. If an expedited submittal review process is implemented on this Project, the equipment manufacturers, material suppliers list and submittals index will have to be submitted early to meet the requirements of the expedited submittal review procedure.
 - D. Upon receipt of the approved manufacturers and material suppliers list, the Contractor shall immediately obtain complete Shop Drawings, Product Data and Samples and equipment and material Specification Compliance Review documents from the manufacturers, suppliers, vendors and all Division 22 Contractors, for all materials and equipment as specified herein in various sections of the specifications and shall submit data and details of such materials and equipment for review by the Architect and Engineer. Prior to submission of the Shop Drawings, Product Data and Samples to the Architect and Engineer, the Contractor shall thoroughly review the Shop Drawings, Product Data and Samples and verify they are in compliance with the Contract Documents. The Contractor shall provide a compliance review provided with the Contractor's Compliance Review will be a paragraph-by-paragraph review of the specifications with the following information marked for each Specification section paragraph or in the margin of the original Specification and any subsequent Addenda.
 1. "C": Comply with no exceptions.
 2. "D": Comply with minor deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 3. "E": Exception. Equipment, product or material does not comply. For each and every exception, provide a numbered footnote with reasons for each exception and suggest possible alternatives for the Owner's consideration.

4. “N/A”: The specification paragraph does not apply to the proposed equipment, material or product.
5. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Contractor is in complete compliance with the Contract Documents. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not.
6. The Contractor shall check all materials and equipment upon their arrival on the Project Site and verify their condition and compliance with the Contract Documents. Any work, which proceeds prior to receiving “Approved”, Shop Drawings shall be modified as required to comply with the Contract Documents and the “Approved” Shop Drawings. A minimum period of fifteen (15) Working days, exclusive of transmittal time, will be required in the Engineer’s office each time a Shop Drawing, Product Data and/or Sample is submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling his work.
7. The review of Shop Drawings, Product Data and Samples by the Architect and Engineer shall not relieve the Contractor of the responsibility for dimensions of errors that may be contained therein for deviations from requirements in the Contract Documents. It shall be clearly understood that the noting of some errors by the Engineer but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, Product Data and Samples, the Contract Documents shall govern the Work and are neither waived nor superseded in any way by the review of Shop Drawings, Product Data and Samples.
8. The Contractor shall observe the following procedures when submitting Shop Drawings, Product Data and Samples:
 - a. Shop Drawings - Each Shop Drawing shall indicate in the lower right hand corner and each Product Data brochure shall indicate on the front cover of the following: the submittal identification number; title of the sheet or brochure; name and location of the Project; names of the Architect, Engineer, Contractor, Subcontractor, manufacturer, supplier and vendor; the date of submittal and the date of each correction and revision. All pages and drawings in Product Data brochures shall be numbered consecutively from beginning to end. So far as is practical, each Shop Drawing, Product Data and/or Sample shall bear a cross reference note to the page number or numbers of the sheet of the Drawings and/or Specifications showing the Work. Unless the above information is included, the submittal will be returned for re-submittal. Re-submittals of Product Data or brochures shall be complete and shall include a cover letter summarizing the corrections made in response to the review comments and the submittal page numbers, which were revised.

- b. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections and schematics to clearly describe the work. Drawings shall be prepared by a drafter or CAD technician skilled in this type of work. All sheet metal, piping, fire protection and similar Shop Drawings shall be drawn to at least $3/8" = 1'-0"$ scale. The Contractor shall submit Shop Drawings as described below. Shop Drawings, which do not comply with these requirements, will be returned for re-submittal.

The submittal shall consist of one (1) direct reading, clearly legible, PDF of each Shop Drawing. The Architect and Engineer will each review the PDF Shop Drawings. After review of the Shop Drawings by the Engineer, shall require the following action:

- 1) "APPROVED" means that fabrication; manufacture, installation or construction may proceed in compliance with the Submittal and the Construction Documents
 - 2) One reviewed redlined PDF will be returned to the Contractor.
 - 3) No additional submittal is required for the "APPROVED" Shop Drawings.
- c. "APPROVED AS NOTED" means that fabrication, manufacture, installation or construction may proceed in compliance with the Submittal, as annotated by the Engineer, and the Construction Documents, and, if noted, the contractor shall revise and resubmit the Submittal to incorporate the Engineer's annotated comments. If, for any reason, the Contractor shall make revisions to the Submittal in comments, the Contractor shall make revisions to the Submittal in order to incorporate those comments with which it can comply and resubmit the revised Submittal with a statement setting forth the comments with which it cannot comply and the reasons therefore.
- 1) The Owner, Architect and Engineer will each retain one (1) original PDF.
 - 2) One reviewed redlined PDF will be returned to the Contractor.
 - 3) The Contractor shall forward a written response to the items noted within fourteen (14) days of the Engineer's review date stamped on the Shop Drawing. The response must be certified as specified. Upon receipt of a satisfactory response, the status of the submittal will be revised to "APPROVED" by a written document to the Contractor prepared by the Engineer. If the response is not received by the Engineer in (14) days of the Engineer's review date stamped on the submittal, the "APPROVED" status will be rescinded by a written document to the Contractor prepared by the Engineer.

9. "REVISE AND RESUBMIT" means that a portion of the Submittal does not comply with the design intent of the Construction Documents. Other portions of the Submittal, as noted, may proceed with fabrication, manufacture, installation or construction in compliance with the Submittal, as annotated by the Engineer, and the Construction Documents. The Contractor shall revise or replace the disapproved portions of the Submittal as noted and resubmit the entire revised or replaced Submittal.
 - a. The Owner, Architect and Engineer will each retain one (1) PDF print.
 - b. The reviewed PDF will be returned to the Contractor.
 - c. The submittal shall be corrected in accordance with Contract Documents and resubmitted in whole for review. Note: The returned PDF stamped "REVISE AND RESUBMIT" may not be resubmitted.
 - d. If the submittal is returned to the Contractor marked "DISAPPROVED," only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional resubmittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.

10. "DISAPPROVED" means that the Submittal does not comply with the design intent of the Construction Documents. Submittals stamped "Disapproved" are not to be used. The Contractor shall revise and resubmit the Submittal.
 - a. The Owner, Architect and Engineer will each retain one PDF print.
 - b. The reviewed redlined PDF will be returned to the Contractor.
 - c. The submittal shall be corrected in accordance with Contract Documents and resubmitted in whole for review. Note: The returned PDF stamped "DISAPPROVED" may not be resubmitted.
 - d. If the submittal is returned to the Contractor marked "DISAPPROVED", only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
 - e. Subsequent submittals of any Shop Drawing previously marked "NOT APPROVED, REVISE AND RESUBMIT" shall have all corrections or other revisions clearly identified.

- f. If the copy stamped “APPROVED” is altered for any reason after it has been stamped, the “APPROVED” shall automatically be voided.
- g. All work shall be done in accordance with Shop Drawings stamped “APPROVED” insofar as these are in agreement with the Contract Documents. The “APPROVED” Shop Drawings shall be used in conjunction with the preparation of the Coordination Drawings specified hereinafter. Wherever differences occur between the Shop Drawings and the Contract Documents, the Contract Documents shall govern the work.
- h. Shop Drawing Review
 - 1) The purpose of the review of shop drawings is to maintain integrity of the design. Unless the contractor clearly points out changes, substitutions, deletions or any other differences between the submission and the Contract Documents in writing on the Contractor’s compliance review form, approval and/or review by the Engineer or Architect does not constitute acceptance. It is not to be assumed that the Engineer has read the text nor reviewed the technical data of a manufactured item and its components except where the Vendor has pointed out differences on the Contractor’s compliance review form between his product and the specified equipment, material or product. Any notations or markings on shop drawings made by the Architect/Engineer, which Contractor considers a change shall be immediately brought to the attention of the CM by submitting a formal Change Order Request. Procedure of fabrication of installation prior to such notification shall be at this Contractors risk.
 - 2) It is the responsibility of the contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by him with other trades during the preparation of the contractor’s coordination drawings. Final Review of shop drawings containing errors does not relieve the contractor from making corrections at his expense.
 - 3) No shop drawings stamp or note shall constitute an order to fabricate or ship.
 - 4) The Contractor is responsible for seeing that “Approved” copies of shop drawings bearing the approval of the Architect/Engineer or Owner’s Consultant are kept on the job site and work is implemented in the field in accordance with these documents.
 - 5) Where information from one Contractor is required by another contractor, it is the responsibility of the contractors to exchange information and coordinate their work.

1.9 COORDINATION DRAWINGS

- A. The Contractor and all Subcontractors shall prepare a complete set of construction coordination drawings ("Coordination Drawings") indicating the equipment actually purchased and the exact routing and elevations for all lines such as piping, busway, conduit, ductwork, etc., including conduit embedded in concrete and openings, sleeves, etc., required in the structure, walls, partitions, etc.
- B. The Coordination Drawings shall be submitted complete for demonstration of compliance to the Architect, Engineer and Owner. All structural elements, footings, slab elevations and thickness shall be indicated.
- C. The sheet metal drawings prepared on electronic media (CAD) at a scale not less than $3/8" = 1'-0"$, shall serve as the base Drawings to which all other Contractors will overlay and add their Work. Each trade shall draw their Work on separate layers represented by individual colors. Each Coordination Drawing shall be completed and signed off by the other Contractors and the Contractor prior to the installation of the Work in the area covered by the specific Coordination Drawing.
- D. Any Work installed before coordinating with the Work of the other trades, shall be subject to removal and re-installation as required to correct the condition without extra cost to Owner.
- E. The Coordination Drawings shall indicate piping, conduit, busway and equipment support points and loads exceeding 500 lb. imposed on the building structure. Drawings shall be submitted to the Architect and Engineer of record for review. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points and the size of all lines shall be indicated. All beam penetrations, slab penetrations and sleeves shall be indicated, sized and coordinated with all other Work. All required code clearance space and required maintenance access space shall be indicated and coordinated with all other work. All Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated.

1.10 RECORD DOCUMENTS

- A. The Contractor shall maintain on a daily basis at the Project Site a complete set of Project Record Documents on the electronic backgrounds provided by the Engineer. The Project Record Documents shall consist of continuously updated AutoCAD files of the provided Engineers drawings for this Division. The AutoCAD files shall be electronically updated by the Contractor during the construction period to show the precise location of all buried or concealed work and equipment, including embedded piping and valves, field modifications and all changes and deviations in the Divisions Plumbing work from that shown on the Contract Documents. These record drawings will be submitted to the G.C., C.M., Architect, Engineer and authority having jurisdiction when requested.

- B. The Contractor shall maintain on a daily basis at the Project Site a complete set of Project Record Documents. The Project Record Documents shall consist of continuously updated AutoCAD files of the Coordination Drawings for this Division. The AutoCAD files shall be electronically updated by the Contractor's technician during the construction period to show the precise location of all buried or concealed work and equipment, including embedded piping and valves, field modifications and all changes and deviations in the Plumbing work from that shown on the Contract Documents.
- C. The Contractor shall maintain on site a record of testing records, and pre-functional and functional testing forms and records.
- D. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without written definite instructions from the Architect or Engineer. Prior to commencing work, the Contractor shall obtain from the Architect or Engineer a set of AutoCAD format Drawings on compact disks, to be used only to produce the Coordination Drawings. The continuously updated Coordination Drawings shall be used to produce the final Project Record Documents, which shall be delivered to the Owner in latest version AutoCAD format CD-RW Recordable Rewrite Compact Discs upon Final Completion of the Project. The Contractor shall give to the Architect and Engineer a written release acceptable to the Architect and Engineer signed by a corporate officer of the Contractor prior to receipt of the Architect's and Engineer's compact disks.
- E. Record dimensions shall clearly and accurately delineate the work as installed; locations shall be suitable identified by at least two (2) dimensions to permanent structures.
- F. Prior to final acceptance of the work of this Division, the Contractor shall submit properly certified Project Record Documents to the Architect and Engineer for review and shall make changes, corrections or additions as the Architect and/or Engineer may require to the Project Record Documents. After the Architect's and Engineer's review and any required Contractor revisions, the Project Record Documents shall be delivered to the Owner on CD-RW Recordable Rewrite Compact Discs in latest AutoCAD format.
- G. Prepare project record documents in accordance with the requirements in Division 1 and as specified herein. In addition comply with the following.
 - 1. A complete set of "as-built" or record drawings shall be made up and delivered to the Architect.
 - 2. The drawings shall show:
 - a. Piping systems, with valves and control devices located and numbered as shown on plans and with items requiring maintenance located (i.e., traps, strainers, PRVs, backflow devices, tanks, etc.). Valve location diagrams, complete with valve tag

chart. Refer to Division 22 "Section "Plumbing Identification." Indicate horizontal locations of underground piping.

- b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
- c. Actual equipment and materials installed.
- d. This trade shall submit the as-built project record documents set for approval by the building department in a form acceptable to the department, when required by the jurisdiction.
- e. Any deviations to original design document the Building Department filed documents for purposes of amended re-filing with the building department for amendment. Contractor to include amended schedule and fixture counts. Any such deviations shall be bubbled on the drawings. Such Drawings shall be submitted a minimum of 3 weeks prior to substantial completion of the project or as requested by the Owner or authority having jurisdiction.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall provide operating instructions and maintenance data books for all equipment and materials furnished under this Division as well as assist the CA in compiling and consolidating O&M information during the development of the site specific Commissioning Plan.
- B. Deliver two (2) initial copies of the operation and maintenance manuals to the Owner and Engineer for review with the equipment submittals. The initial copies shall contain all the information available at the time of submission.
- C. Submit six (6) final copies of operation and maintenance manuals to the Owner and Engineer for review at least two (2) months prior to training along with the training outlined. Assemble all data in a completely indexed volume or volumes in three ring binders and identify the size, model and features indicated for each item. The binders shall have the Project Name and Logo printed on the outside of the binders. Re-submittals of these final size (6) copies of the "Approved" operation and maintenance books and two (2) electronic CD-RW recordable rewrite compact disc shall be delivered to the Owner upon Final Completion of the Project.

Vendor / Manufacturer shall supply complete operations and maintenance manuals in accordance with the following requirements:

1. The operations and maintenance manual documentations shall be presented in an Avery 3" heavy duty white binder or equivalent at the time of original submission, and record manuals within four weeks of integrated delivery of equipment to the site.
 2. The binder shall have a cover page depicting the system(s) covered by the manual, the Owners name, site location, and date.
 3. The binder shall contain a detailed table of contents page delineating all major sections of the manual. Each section of the manual shall have an Avery narrow tab type divider placed between sections (properly labeled) to ensure easy access. The major sections of the manual shall include:
 1. Manual index
 2. Specification Section reference number and index.
 3. Equipment and/or material model number and serial numbers.
 4. Identifying name, mark number, plan/drawings tagging, etc.
 5. Locations of major equipment (where several similar items are used, provide a list).
 6. Manufacturer's catalogue literature including model, type, style, complete standard factory operations manual, brand name data, etc.
 7. Installation manual
 8. Operations manual
 9. Maintenance manuals and recommended periodic maintenance and schedules.
 10. Plumbing plans and riser diagrams.
 11. Supplier, dealer, distributor, vendor and service organizations including phone, fax and e-mail addresses and name of contact person.
 12. "Approved" or approved submittals.
 13. Dimensional drawings with equipment weights
 14. List of spare parts recommended for normal service requirements.
 15. Assembly and disassembly instructions with exploded view Drawings where available.
 16. Manufacturer's recommended operation and maintenance instructions with all non-applicable information deleted.
 17. Trouble shooting diagnostic instructions where available.
 18. Copy of all welding certifications.
 19. Copy of all warranties and guarantees.
 20. Copy of all factory and field test reports.
 21. Completed Functional Test sheets.
 22. Completed Pre-functional checklists.
 23. Copies of all "Data Register" Sheets (see Specifications 230593, Testing, Balancing and Adjusting, Part 1, General, Submittals, Item E.1. (d))
- D. Include the following information where applicable:
1. Manual index
 2. Specification Section reference number and index.
 3. Equipment and/or material model number and serial numbers.
 4. Identifying name, mark number, plan/drawings tagging, etc.
 5. Locations of major equipment (where several similar items are used, provide a list).
 6. Manufacturer's catalogue literature including model, type, style, complete standard factory operations manual, brand name data, etc.
 7. Installation manual
 8. Operations manual
 9. Maintenance manuals and recommended periodic maintenance and schedules.
 10. Plumbing plans and riser diagrams.
 11. Supplier, dealer, distributor, vendor and service organizations including phone, fax and e-mail addresses and name of contact person.
 12. "Approved" or approved submittals.
 13. Dimensional drawings with equipment weights
 14. List of spare parts recommended for normal service requirements.
 15. Assembly and disassembly instructions with exploded view Drawings where available.
 16. Manufacturer's recommended operation and maintenance instructions with all non-applicable information deleted.
 17. Trouble shooting diagnostic instructions where available.
 18. Copy of all welding certifications.
 19. Copy of all warranties and guarantees.
 20. Copy of all factory and field test reports.
 21. Completed Functional Test sheets.
 22. Completed Pre-functional checklists.
 23. Copies of all "Data Register" Sheets (see Specifications 230593, Testing, Balancing and Adjusting, Part 1, General, Submittals, Item E.1. (d))
- E. Items required for inclusion in the operations and maintenance manuals that cannot be provided at the time the O&Ms are initially submitted for review are expected to be submitted within ten (10) weeks of completion of the work in a format for insertion into the binder under a pre-fabricated tab that is identified in the table of contents (i.e., the site acceptance test may not be

complete at the time this manual is required for submission, in this case the manufacturer shall submit the manual with this section empty, upon completion of the site acceptance testing the forms for this testing will be supplied (punched for the binder)).

- F. All documents shall be submitted electronically by computer disk in a dedicated sleeve within the binder.

1.12 CODES, PERMITS AND INSPECTIONS

- A. All work shall meet or exceed the latest requirements of all national, state, county, municipal and other authorities exercising jurisdiction over construction work at the project. These include, but are not limited to the following:
 - 1. NFPA National Fire Codes
 - 2. New York State Department of Health
 - 3. New York State Building Codes as modified by Westchester County (Plumbing, Fire Protection, Fuel Gas, Mechanical).
 - 4. FM Global Engineering Requirements
- B. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the work.
- C. Any portion of the work, which is not subject to the approval of any authority having jurisdictions, shall be governed by the applicable sections of the overall Westchester Building Code.
- D. Installation procedures, methods, and conditions shall comply with the latest requirements of The Federal Occupational Safety and Health Act (OSHA).
- E. Provide and pay for the cost of the Controlled Inspections as called for in the New York State Building Code, Sections 27-132 and Section 27-136 and for filing all necessary building department reports for approval, Form TR-1, with the building department. Submit the name of the registered Professional Engineer who will be responsible for making the inspections for the Owner on Form TR-1 as soon as possible or within 90 days of the award of contract for approval by the Engineer of Record and Owner and file Form TR-1 with the building department.
- F. Prepare and submit to the Construction Manager, General Contractor, Architect, Owner, Engineer or authority having jurisdiction, as requested at any time, for building department filing, refiling or PAA, a set of current record documents in a form acceptable to Architect and

Engineer. Such record documents shall be the most current set of documents as maintained by the contractor in accordance with the requirements as noted in Section 1.9A record documents above. Any revisions to previously approved filings shall be clearly identified on the record documents. For T.C.O. requirements documents shall be provided a minimum of 6 weeks prior to T.C.O. or as requested from Construction Manager, General Contractor, Architect, Owner, Engineer or authority having jurisdiction from authorities having jurisdiction.

- G. This Contractor shall prepare all plans, amendments and pay all filing fees that will be required for the fuel burning installation, including boiler plant, gas/oil fired chillers, chimney, oil piping, fuel oil tanks, gas piping, breeching, and any or all parts of the system under the jurisdiction of the controlling agencies.
- H. This Contractor shall prepare all plans, amendments and pay all filing fees that will be required for the emergency generator installation, including oil piping, engine exhaust, fuel oil tanks, and any or all parts of the system under the jurisdiction of the controlling agencies.
- I. This Contractor shall prepare all plans, amendments, and pay all filing fees that will be required for the electric generator and electric generator fuel oil tank installation.
- J. This Contractor shall be responsible for the installation and filing until the installation has been approved by the authorities having such jurisdiction.
- K. All welding of high-pressure steam over 15 psig and High Temperature Hot Water Piping shall be under controlled inspection of an Engineer supervising a welding inspection agency acceptable to the Department of Buildings. All costs associated with testing and inspection, including, x-rays, professional services and fees shall be paid by this contractor.
- L. Kitchen fire extinguishing system is to be filed by contractor where required by the controlling agency.

1.13 COORDINATION OF WORK BETWEEN TRADES

- A. The Plumbing Trade is required to supply all necessary supervision and coordination information to any other trades who are to supply work to accommodate the Heating, Ventilating and Air Conditioning installations.
- B. The Plumbing Trade is required to supply all necessary supervision and coordination of all other trades required for the storage, transportation, installation, start-up, testing and commissioning of pre-purchased equipment.
- C. Where the Plumbing Trade is required to install items, which it does not purchase, including pre-purchased equipment, it is required that this contractor assumes all responsibilities

associated with the equipment as if they had purchased the equipment directly. This shall include but is not limited to the following:

1. The coordination of their delivery including prior notifications and overseeing the filing of all claims.
 2. Equipment is to be purchased inclusive of freight to an initial point of delivery. Contractor is to coordinate and assumes all costs for receipt at, storage at, and transportation to the site from a rigger's yard.
 3. Their unloading from delivery trucks driven in to any designated point on the property line at grade level.
 4. Their safe handling and field storage up to the time of permanent placement in the project.
 5. Their protection and periodic maintenance up to the time of Owner takeover of these responsibilities as defined by start-up, Owner acceptance, and warranty conditions defined herein.
 6. The correction of any damage, defacement or corrosion to which they may have been subjected.
 7. Their field assembly and internal connection as may be necessary for their proper operation.
 8. Their mounting in place including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to Architectural and structural conditions.
 9. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
 10. All labor including but not limited to installation, start-up, commissioning and warranty.
 11. Any and all documentation to be provided as required by the contract documents.
- D. Items, which are to be installed but not purchased as part of the work of the Plumbing Trade, shall be carefully examined by this trade upon delivery to the project. Claims that any of these items have been received in such condition that deviates from information previously provided that their installation will require procedures beyond the reasonable scope of work of the Plumbing trade will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The work of the Plumbing trade shall include all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.
- E. Where multiple contracts are awarded involving the same trade for either base contract work or tenant fit-out, contractors shall coordinate their work and provide sufficient labor for the testing of the system as a whole.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Unit shall be stored and handled in accordance with manufacturer's instructions.
- C. Unit shall be shipped with all listed items and control wiring factory installed unless noted on the submittals and approved prior to shipment.
- D. Unit shall be shipped complete as specified. Parts for field installation shall not be shipped and stored on site without prior to shipment.
- E. Rigging: Units shall be fully assembled. Units requiring disassembly for rigging shall be factory assembled and tested. Disassembly, reassembly and testing shall be supervised by the manufacturer's representative.
- F. Unit shall be shipped with firmly attached labels that indicate name of manufacturer, model number, serial number, and plan tagging.
- G. The Vendor shall shrink-wrap all electronic equipment and spare parts prior to shipping. Spare parts are to be delivered at time of Owner acceptance.

1.15 PRECONSTRUCTION CONFERENCE PRIOR TO START OF WORK

- A. Prior to commencing any work, the CM, together with designated major Contractors, shall confer with the Architect and Engineer concerning the work under the Construction Contract.
- B. The pre-construction conference will be conducted under the leadership of the CM and will occur soon after the CM notifies the Subcontractors of contract award. The pre-construction conference will focus on items such as the expedited submittal review procedure, interface and coordination between Contractor work scope, the CM's project site rules and requirements, temporary utility requirements, CM's construction schedule, etc.

1.16 CLEANING AND ADJUSTING

- A. It shall be this trade's responsibility to store its materials in a manner that will maintain an orderly clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks and covered with tarpaulins.
- B. Equipment and material, if left in the open and damaged, shall be repainted or otherwise refurbished at the discretion of the Owner. Equipment and material is subject to rejection and re-

placement if, in the opinion of the Engineer or in the opinion of the manufacturer's Engineering department, the equipment has deteriorated or been damaged to the extent that its immediate use is questionable, or that its normal life expectancy has been curtailed.

C. Cleaning of Piping System (General)

1. During construction, properly cap, plug, and cover all opening in piping lines and equipment nozzles so as to prevent the entrance of sand, dirt, etc. Each system of piping shall be flushed (for the purpose of removing grit, dirt, sand, etc., from the piping), for as long a time as is required to thoroughly clean the systems.
2. Upon completion of the work, all fixtures, trimmings and equipment shall be thoroughly cleaned, polished and left in first class condition for final acceptance.

D. After completion of project clean the exterior surface of equipment included in this section, including concrete residue.

E. Adjusting (General)

1. After the entire installation has been completed, make all required adjustments to balancing valves, air vents, automatic controls, circulators, flush valves, faucets, shower valves, mixing valves, pressure reducing valves, etc., until all performance requirements are met. All water circulating systems shall be properly balanced.
2. All bearing of all equipment shall be oiled or greased as recommended by the manufacturer, after installation.
3. The alignment of each centrifugal pump shall be checked and each pump shall be properly aligned after the piping is completed and before the pumps are placed in service.
4. Mechanical seals and shaft sleeves shall be replaced by this Contractor without charge in the event that unusual wear of faulty operation occurs during the guarantee period.

1.17 EQUIPMENT AND MATERIALS

- A. All equipment and materials shall be new and without blemish or defect.
- B. Equipment and materials shall be products, which will meet with the acceptance of the agency inspecting the mechanical work. Where such acceptance is contingent upon having the products examined, tested, and certified by Underwriters' or other recognized testing laboratories, the product shall be so examined, tested and certified.
- C. Where no specific indication as to the type of quality of material or equipment is indicated, a first class standard article shall be furnished.
- D. It is the intent of these specifications that wherever a manufacturer of a product is specified and the terms "other approved" or "or approve equal" or "equal" are used, the substituted item must

conform in all respects to the specified item. Consideration will be given to claims that the substituted item meets the performance requirements with lesser construction (such as lesser heat exchange surface, etc.). Performance as delineated in schedules and in the specifications shall be interpreted a minimum performance. In many cases equipment is oversized to allow for minimum performance. In many cases equipment is oversized to allow for pick-up loads, which cannot be delineated under the minimum performance.

- E. All equipment of one type (such as valves, pumps, etc.) shall be the product of one manufacturer.
- F. Substituted equipment or optional equipment, where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether approved or not, shall be replaced at the Subcontractor's expense.
- G. Note that the approval of shop drawings, or other information submitted in accordance with the requirements hereinbefore specified does not assure that the Engineer, Architect, or any other Owner's Representative, attests to the dimensional accuracy or dimensional suitability of the material or equipment involved, or the ability of the materials or equipment involved or the mechanical performance of equipment. Approval of shop drawings does not invalidate the plans and specifications in the conflict.
- H. Substitutions of Plumbing Equipment for that shown on the schedules or designated by model number in the specifications will not be considered if the item is not a regularly cataloged item shown in the current catalog of the manufacturer.

1.18 PROTECTION OF EQUIPMENT AND MATERIALS

- A. All equipment materials and work shall be protected under this contractor's responsibility.
- B. This contractor shall be responsible for all equipment, materials and work until final inspections and testing and acceptance. Protect all work against theft or damage, which is not immediately installed. All materials, equipment and work shall be covered and protected from damage due to water, weather, construction debris or installations, spray on fireproofing, insulation or acoustical treatments. All open ends of work shall be protected shall be closed with temporary plugs or caps as required to prevent entry of any objects.
- C. Protect the plumbing system from freezing during cold weather.
- D. Before commissioning of systems or equipment, remove all protective materials, shipping blocks, etc.
- E. All equipment and materials delivered to the site to be kept in factory packaging until installation.

- F. No permanent equipment shall be used during the progress of the work.
- G. All metal plumbing fixture trims and supplies shall be protected from damage once installed. Provide non-corrosive cover coating for all fixture trims and supplies until construction work is complete.

1.19 MISCELLANEOUS FIRE PROTECTION

- A. In addition to fire protection means specified elsewhere in this specification, this trade shall comply with the following:
 - 1. All spaces between pipes and their respective sleeves shall be packed full depth with mineral wool or other equally fire resistant material and compressed firmly in place. Fiberglass shall not be used. Sleeve clearances shall not exceed 1/2-inch between pipes (or ducts) and sleeves. Use individual sleeves for each pipe. Before escutcheons are attached, caulking must be available for inspection and notification should be made.

1.20 FIRE STOPPING

- A. General
 - 1. Provide firestopping in fire-rated floors or walls for the purposes of passing building service penetrants such as piping.
 - 2. Provide complete submittals indicating the following:
 - a. Manufacturer's literature, specification and installation instructions.
 - b. Certificates indicating that said materials conform to specified requirements.
 - c. Evidence of UL classification, factory mutual systems approval, or equivalent third party testing.
- B. Products & Application
 - 1. Materials specified are kbs and/or flame-safe firestop systems as manufactured or sold by IPC (International Protective Coatings Corporation) or approved equal in accordance with the following.
 - a. All firestopping materials and fire stop designs shall be water-resistant and shall be insoluble in water when dried or cured (where said drying and/or curing is required to firetrap functionality). All fire stopping materials shall be capable of maintaining functionality under conditions of high humidity or transient exposure to water.

- b. Materials shall be compatible with all materials used in the system including materials used in or on penetrants, as well as all construction materials used in conjunction with the system. No solvent based materials shall be used unless specific test documentation is provided certifying compatibility with all contact materials.
- c. Flammability and outgassing: all materials supplied under this specification, shall pose no particular fire hazard in storage, installation, cure or under in-service conditions.
- d. Installations subject to movement of penetrants: openings with penetrants subject to movement or vibration shall be sealed with products and systems designed to accommodate such movement without reduction or loss of functionality.
- e. Installations subject to frequent retrofit: materials and designs provided of thorough-penetrations where changes of penetrants will be made on a frequent basis shall be capable of retrofit without damage to system.

C. Execution:

- 1. Contractor shall examine areas where firestopping is required or review drawings as necessary prior to beginning work or submitting data or submittals required as per this specification. Data to be submitted shall be based upon the findings of the contractor's examination.
 - a. Contractor shall include in his submittals, proposed system designs based upon his inspection and a review of the Engineering drawings. The contractor shall determine the nature of the penetration.
- 2. Install penetration seals as per design requirements in accordance with manufacturer's instructions.
- 3. Identify damaged, improperly installed or reentered seals for repair or modification.
- 4. All seals shall be inspected for proper installation, drying curing, adhesion as appropriate for the materials and systems being used. Where necessary, repairs shall be made and repaired installation shall be re-inspected.

1.21 ACCESS DOORS IN GENERAL CONSTRUCTION

- A. Access doors as required for operation and maintenance of concealed equipment, valves, controls, etc., will be provided by this subcontractor and installed under another section of the work.
- B. This trade is responsible for access door location, size and its accessibility to the valves or equipment being served.

- C. Coordinate and prepare a location, size and function schedule of access doors required, and deliver to a representative of the installing section.
- D. Access doors shall be of ample size, minimum of 16" x 16". Type as specified under another Section 083113.

1.22 PAINTING

- A. All finished painting shall be performed by another section except for standard factory finishes.
- B. All electrical motors, pumps casings and other apparatus shall be provided with three (3) coats of machinery enamel at the factory and after installation shall be carefully cleaned, rubbed down and oiled.
- C. For protective coatings of other equipment such as hangers, etc., refer to that section of the specification wherein construction data is described
- D. Provide prime coat painting for the following:
 - 1. Piping in all exposed to view areas.
 - 2. Miscellaneous steel and iron provided by this Trade.
 - 3. Hangers and supports.

1.23 EXCAVATION AND BACKFILL

- A. All excavation and backfill will be performed by the general construction contractor. This Subcontractor shall be responsible for the coordination of trench routing, slope and elevation and shall supervise the grading, backfilling, etc., of trenches in which Plumbing work is laid.

1.24 QUIET OPERATION

- A. All equipment and material shall operate under all conditions of load without any objectionable sound or vibration, which in the opinion of the Owner is objectionable. After the systems are installed and in operation it shall be the responsibility of this Trade to make any changes in equipment or work installed to provide systems that are quiet in operation. Where sound or vibration conditions arise which are considered objectionable by the Owner, eliminate same in a manner reviewed by the Owner at no additional cost to the Owner.

1.25 GUARANTEES, CERTIFICATIONS AND WARRANTY PERIOD

- A. Contractors and their Manufacturers shall provide a 1-year full parts and labor warranty. Contractor must maintain a local full time service company with 24-hour emergency service capable of responding to service needs within 4-hours. Contactor shall be aware that during the full warranty period as defined above, Manufacturers of certain pre-purchased equipment as called for in purchase agreements by the CM are to provide all required periodic and routine service and maintenance. The Manufacturers through the Contractor shall submit a service and maintenance plan for approval by the Owner. The Manufacturer must comply with the requirements of Owner's Service Contract terms and conditions. When purchase agreements are made the responsibility of this Contractor, all service agreements called for in specification sections shall be made part of the initial purchase and shall pass directly to the Owner. All other equipment, systems and related appurtenances shall be the responsibility of the Contractor for warranty. All warranty claims whether for pre-purchased or direct purchased equipment shall be the responsibility of the Contractor.
- B. During the warranty period, the Contractor shall guarantee the following in a form satisfactory to the Owner:
 - 1. All work installed will be free from any and all defects in Workmanship and/or materials.
 - 2. All apparatus will develop capacities and performance characteristics specified.
 - 3. The systems shall operate without malfunction.
- C. The Contractor shall, without cost to the Owner, remedy any defects within a reasonable time to be specified in notice from the Architect. In default thereof, the Owner may have such Work done and charge all costs to the Contractor.
- D. The start of the Contractor's warranty period, as defined above, shall have no restrictions on start date and extend for the full period noted.
- E. The Contractor shall confer with the CM prior to the bid date concerning the Schedule and determine if there is a need to operate any items of equipment or systems for temporary heating and/or cooling or other reasons prior to substantial completion. All required extended warranty costs for equipment, materials and systems shall be included in the Contractor's proposal and clearly designated with a breakout price. All equipment or systems used for temporary heating and/or cooling shall be restored to "as new" condition by this Contractor and all associated costs shall be included in the Contractor's bid proposal.

1.26 CONNECTIONS TO EXISTING WORK

- A. Plan installation of new work and connections to work previously installed or put in place by others to insure minimum interference with regular operation of existing and surrounding facilities. Submit to the Owner for approval, date schedule of necessary temporary shutdowns

of existing services. All shutdowns shall be made at such times as will not interfere with regular operation of existing facilities and only after written approval of Owner. To insure continuous operation, make all necessary temporary connections between new and existing work. All costs resulting from temporary shutdowns shall be borne by this Contractor.

- B. All shutdowns shall be done on overtime (for bid purposes - exact times at the discretion of the Owner or as directed by authorities having jurisdiction).
- C. The drawings may not utilize symbols and schematic diagrams to indicate connections to existing work. If used, these do not have any dimensional significance nor do they delineate every item required for the intended installations nor do they represent a division of responsibility between contracts.
- D. The contractor shall coordinate all connections to existing work with the CM. Contractor shall field verify exact location of all existing services.
- E. Connect new work to existing work in neat and approved manner. Restore existing work disturbed to original condition.
- F. Water supplies to areas requiring demolition shall be scheduled and shutdown prior to commencement of any demolition.

1.27 FINAL REVIEW AND ACCEPTANCE

- A. At a time designated by the Owner and after Commissioning of the systems, the entire system will be reviewed for compliance with the Contract Drawings and Specifications. The Contractor shall be available at all times during this review.
- B. Prior to the Final Review field visit, the Contractor will submit to the Engineer a written certification that: 1) attests to the Contract Document compliance for this Project prior to the Engineers Final Review field visit, and 2) certifies that the equipment and materials installed in this project under this Division contain no asbestos or P.C.B.
- C. Operate the entire system properly with all systems balanced and all controls adjusted for a minimum period of ten (10) days.
- D. Certificates and Documents required herein to be in order and presented to the Engineer at least two (2) weeks prior to the Final Review.
- E. After the Final Review, any changes or corrections noted as necessary for the work to comply with the requirements of the contract documents are to be accomplished without delay in order to secure final acceptance of the work.

END OF SECTION

SECTION 220517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART I - 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. Sleeves.
- 2. Stack-sleeve fittings.
- 3. Sleeve-seal systems.
- 4. Sleeve-seal fittings.
- 5. Grout.
- 6. Silicone sealants.

- B. Related requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Sustainable Design Submittals:

- 1. Product Data: For sealants, indicating VOC content.
- 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. GPT Industries.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. GPT; an EnPro Industries Company.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials, Inc.

- c. Polymeric Systems, Inc.
 - d. Schnee-Morehead, Inc., an ITW Company.
 - e. Sherwin-Williams Company (The).
2. Sealant shall have VOC content of 250 g/L or less.
 3. Sealant shall comply with the testing and product requirements of the California Department of Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 2. Sealant shall have a VOC content of 250 g/L or less.
 3. Sealant shall comply with the California Department of Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Smooth-On.
 2. Sealant shall have a VOC content of 250 g/L or less.
 3. Sealant shall comply with the California Department of Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1" annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/2-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- E. Fire-Resistance Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."

3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

- B. Fire-Resistance Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete wall or slab.
- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Leak Test: After following for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150) Steel Pipe Sleeves or Sleeve Seal Fittings.
 - b. Piping NPS 6 (DN 150) and Larger: Sleeve-Seal Fittings.
 - 2. Exterior Concrete Walls Below Grade:
 - a. Piping Smaller Than NPS 6 (DN 150) Steel pipe sleeves with sleeve-seal system or sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch (25mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-Iron pipe sleeves with sleeve-seal system or steel pipe with sleeve-seal system
 - 1) Select sleeve size to allow for 1-inch (25mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves with sleeve-seal system or sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch (25mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Cast-iron pipe sleeves with sleeve-seal system or steel pipe sleeves with sleeve-seal system or sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch (25 mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs Above Grade:

- a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves, stack-sleeve fittings, sleeve-seal fittings.
 - b. Piping NPS 6 (DN 150) and Larger: Steel pipe sleeves or stack-sleeve fittings.
5. Interior Partitions:
- a. Piping Smaller Than NPS 6 (DN 150): Steel pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel sheet sleeves.

END OF SECTION

SECTION 220518

ESCUTCHEONS FOR PLUMBING PIPING

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. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Dearborn Brass.
 - 3. Jones Stephens Corp.
 - 4. Keeney Manufacturing Company (The)
 - 5. Mid-America Fittings, Inc.
 - 6. ProFlo; a Ferguson Enterprises, Inc. brand

2.2 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.3 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

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.
- B. Vibration, noise, wind & flood criteria for this section is referenced in specification section 230548 and 230548-A. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Commissioning for Mechanical Services Section 230800
- D. Plumbing Systems Commissioning Section 220800

1.2 SUMMARY

- A. Section includes:
 - 1. Bronze ball valves.
 - 2. Bronze lift check valves.
 - 3. Bronze swing check valves.
 - 4. Iron swing check valves.
 - 5. Iron, center-guided check valves.
 - 6. Bronze gate valves.
 - 7. Iron gate valves.
 - 8. Chainwheels.
- B. Related Sections:
 - 1. Division 22 plumbing piping sections for specialty valves applicable to those sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.
- H. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th 2011 Section 1417. *Add specific state requirements as needed.*

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.
 1. Certification that products comply with NSF 61 Annex G.
- B. Certification that products comply with NSF 61 Annex G.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 2. ASME B31.1 for power piping valves.

3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Lead Free silicon Bronze (ASTM listed) valves shall be made with corrosion-resistant materials. Manufacturer shall provide third party certification tested in accordance with EN ISO 6509 regarding dezincification corrosion resistance and stress corrosion cracking.

B. Refer to Part 3 of Valve Article for applications.

C. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

D. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.

2. ASME B16.1 for flanges on iron valves.
 3. ASME B16.5 for flanges on steel valves.
 4. ASME B16.10 and ASME b16.34 for ferrous valve dimensions and design criteria.
 5. ASME B16.18 for solder-joint connections.
 6. ASME B31.9 for building services piping valves.
- E. NSF Compliance: NSF 61 Annex G [and NSF 372] for valve materials for potable-water service.
- F. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- G. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:
1. Handwheel: For valves other than quarter-turn types.
 2. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- J. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- K. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Grooved: With grooves according to AWWA C606.
 3. Solder Joint: With sockets according to ASME B16.18.
 4. Threaded: With threads according to ASME B1.20.1.
- L. Valve Bypass and Drain Connections: MSS SP-45.

M. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.
5. Copper Press: With sockets according to ASME B16.22/ASTM B75.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze or non metallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze
 - f. Disc: Bronze or Nonmetallic.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

B. Class 150, Bronze Angle Valves with Bronze or Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Milwaukee Valve
 - c. Hammond Valve
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig (2070 kPa).

- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Bronze or Nonmetallic
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Full.

C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Hammond Valve.
- c. Milwaukee Valve Company.
- d. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass (lead free).
- j. Port: Full.

D. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Hammond Valve.

- c. Milwaukee Valve Company.
- d. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110 and ASME A1124.14.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.4 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Kitz Corporation.
- d. Sure Flow Equipment Inc.
- e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-72.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Split body.
- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

2.5 DUCTILE IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Lead Free Aluminum bronze.

B. 300 CWP, Iron, Grooved-End Butterfly Valves with EPDM Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following, subject to compliance with requirements (NSF/ANSI 61 and/or NSF/ANSI 372).

2.6 BRONZE LIFT CHECK VALVES

A. 250 CPW, Lift Check Valves with Nonmetallic TFE Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Description:
 - a. Standard: MSS SP-139
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Vertical or horizontal flow
 - d. Body Material: Silicon bronze (ASTM Listed), corrosion resistant.

- e. Ends: threaded, solder, or Press.
- f. Disc: TFE.

B. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

C. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Flo Fab Inc.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. Mueller Steam Specialty; a division of SPX Corporation.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.

- e. Disc: NBR, PTFE, or TFE.

2.7 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Disc: PTFE or TFE.
- E. 200 CWP, Bronze Sing Check Valves with TFE Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 2. Description:
 - a. Standard: MSS SP-139.
 - b. CWP Rating: 300 psig (1380kPa).

- c. Body Design: Horizontal or vertical (flow in upward direction) flow.
- d. Body Material: Silicon Bronze (ASTM Listed), corrosion resistant.
- e. Ends: Threaded, Soldered, or Press.
- f. Disc: PTFE or TFE.

2.8 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. Hammond Valve.
- b. Milwaukee Valve Company.
- c. NIBCO INC.
- d. Powell Valves.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

B. Class 150, Ductile Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

2. Description:

- a. Standard: MSS SP-136
- b. CWP Rating: 285 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 395 Ductile Iron.
- e. Ends: Flanged.
- f. Trim: Stainless steel.
- g. Gasket: Asbestos free.

C. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.9 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and weight.

2.10 IRON, GROOVED-END SWING CHECK VALVES

A. Class 250, Iron, Grooved Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Description:
 - a. Standard: NSF/ANSI 372.
 - b. CWP Rating: 250 psig (1380kPa).
 - c. Body Material: Ductile Iron, ASTM 536.
 - d. Trim: Silicon bronze (ASTM listed), corrosion resistant.
 - e. Style: Twin disc, spring loaded.
 - f. Ends: Grooved.
 - g. Seat: Buna N.

B. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. Shurjoint Piping Products.
 - c. Tyco Fire Products LP; Grinnell Mechanical Products.
 - d. Victaulic Company.
2. Description:
 - a. CWP Rating: 300 psig (2070 kPa).
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring-operated, ductile iron or stainless steel.

2.11 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal or resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer.
 - e. Seat: Bronze.
- B. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 2. Description:
 - a. Standard: MSS SP-125, FCI 74-1 and MIL-V-18436F.
 - b. Body Material: ASTM A 126 Class B
 - c. Trim: Silicon bronze (ASTM Listed), corrosion resistant.
 - d. Style: globe or wafer, spring loaded.
 - e. Ends: Flanged or wafer.
 - f. Seat: Silicon bronze.
- C. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal or resilient Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: Bronze.

D. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crispin Valve.
- c. DFT Inc.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Spence Strainers International; a division of CIRCOR International, Inc.
- i. Sure Flow Equipment Inc.
- j. Val-Matic Valve & Manufacturing Corp.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer.
- e. Seat: EPDM.

E. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Flomatic Corporation.
- d. Mueller Steam Specialty; a division of SPX Corporation.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 126, gray iron.

- e. Seat: Bronze.

F. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. Val-Matic Valve & Manufacturing Corp.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: Bronze.

G. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: Bronze.

H. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Mueller Steam Specialty; a division of SPX Corporation.
- d. Val-Matic Valve & Manufacturing Corp.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- e. Seat: Bronze.

I. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. Flo Fab Inc.
- b. Sure Flow Equipment Inc.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Wafer, spring-loaded plate.
- d. Body Material: ASTM A 126, gray iron.
- e. Seat: EPDM.

J. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Cooper Cameron Valves TVB Techno.
- c. Crane Co.; Crane Valve Group; Crane Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. NIBCO INC.
- f. Spence Strainers International; a division of CIRCOR International, Inc.
- g. Sure Flow Equipment Inc.

h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 126, gray iron.
- e. Seat: EPDM.

K. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Val-Matic Valve & Manufacturing Corp.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- e. Seat: EPDM.

L. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. Sure Flow Equipment Inc.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Design: Wafer, spring-loaded plate.
- d. Body Material: ASTM A 126, gray iron.

- e. Seat: EPDM.

M. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Sure Flow Equipment Inc.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM.

N. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Val-Matic Valve & Manufacturing Corp.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: EPDM.

2.12 BRONZE GATE VALVES

A. Class 150, Non-Rising Stem (NRS) Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, or bronze.
- B. Class 150, Rising Stem Bronze Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Stem: Bronze.
 - e. Disc: Solid wedge; bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, or bronze.
- C. 200 CWP, Non Rising Stem Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Description:
 - a. Standard: MSS SP-139.
 - b. CWP Rating: 300 psig (1380 kPa).
 - c. Body Material: Silicon bronze (ASTM Listed), corrosion resistant.
 - d. Ends: threaded, Solder, or Press.
 - e. Stem: Silicon bronze, ASTM B99 Alloy C65100.
 - f. Disc: Solid wedge; Silicon bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.13 IRON GATE VALVES

A. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.14 IRON, GROOVED, CHECK VALVE

A. Class 250, Iron, Grooved Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Description:
 - a. Standard: NSF/ANSI 372.
 - b. CWP Rating: 250 psig (1380 kPa).
 - c. Body Material: Ductile iron, ASTM 536
 - d. Trim: Silicon bronze (ASTM listed), corrosion resistant.
 - e. Style: Twin disc, spring loaded.
 - f. Ends: Grooved.
 - g. Seat: Buna N.

2.15 DUCTILE IRON GATE VALVES

A. Class 150, OS&Y &F Non-Rising Stem Ductile Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Description:
 - a. Standard: Lead Free, MSS SP-70, Type I.
 - b. CWP Rating: 285 psig (1380 kPa).
 - c. Body Material: ASTM A 395 Ductile Iron.
 - d. Ends: Flanged.
 - e. Trim: Stainless steel.
 - f. Disc: Solid Wedge.
 - g. Packing and Gasket: Asbestos free.

2.16 DUCTILE IRON GATE VALVES WITH RESILIENT WEDGE

A. Class 125, OS & Y, Ductile Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).

- c. Body Material: ASTM A536 ductile iron.
- d. Ends: Flanged.
- e. Disc: Resilient wedge.
- f. Packing and Gasket: Asbestos free.

2.17 DUCTILE IRON GATE VALVES WITH RESILIENT WEDGE

A. Class 125, NRS, Ductile Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Description:
 - a. Standard: MSS SP-70, Type I,
 - b. CWP Rating: 200 psig (12380 kPa).
 - c. Body Material: ASTM 536 ductile iron.
 - d. Ends: Flanged.
 - e. Disc; Resilient Wedge.
 - f. Packing and Gasket: Asbestos Free.

2.18 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Stem: Bronze.
 - e. Disc: PTFE or TFE.
 - f. Packing: Asbestos free.

- g. Handwheel: Ferrous alloy.

2.19 IRON GLOBE VALVES

A. Class 250, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.20 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.

C. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.

D. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
2. Description:

- a. Standard: MSS SP-78, Type II.
- b. CWP Rating: 400 psig.
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short.
- e. Plug: Cast iron or bronze with sealant groove.

2.21 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular.
 - e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular.
 - e. Plug: Cast iron or bronze with sealant groove.

- C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular.
 - e. Plug: Cast iron or bronze with sealant groove.
- D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular.
 - e. Plug: Cast iron or bronze with sealant groove.
- E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:

- a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular.
 - e. Plug: Cast iron or bronze with sealant groove.
- F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular.
 - e. Plug: Cast iron or bronze with sealant groove.
- G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig (2760 kPa).

- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular.
- e. Plug: Cast iron or bronze with sealant groove.

H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
- 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
 - d. Pattern: Regular.
 - e. Plug: Cast iron or bronze with sealant groove.

2.22 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to ball, butterfly, and plug valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, butterfly, gate, globe, and plug valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

- G. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- H. When soldering use paste fluxes that are approved by the manufacture for use with Lead Free Alloys, meeting ASTM B813.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or gate valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Globe or ball valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: spring-loaded lift valves with nonmetallic disc.
 - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: center-guided metal-seat check valves.
 - c. Sanitary Waste and Storm Drainage Pump Discharge: Spring loaded lift disc check valves.
 - 5. Hot-Water Circulation Piping, Balancing Duty: [Calibrated] [Memory-stop] balancing valves.
 - 6. Drain Duty: Hose-end drain valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.

5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC HOT AND COLD WATER VALVES

A. In general all valves shall be manufactured in the United States. Prior to purchase of any valve manufactured outside the United States the Subcontractor shall submit complete construction details, material list of all components, pressure test data and certified compliance with the reference standards listed herein.

B. Domestic Water Piping Valves:

1. All above ground domestic hot and cold water valves for 200 psig working pressure systems shall be in accordance as listed in the plumbing valves schedule on the drawings and the following.

a. Copper Pipe:

- 1) Ball Valves: In general all copper domestic water valves up to 3" shall be ball type. All valves shall be provided with expansion stems for required insulation systems. Two or three piece full port stainless steel.
- 2) Gate Valves: Copper piping up to and including 4" size, 200# WOG, bronze body with screwed bonnet and solder joints.
- 3) Globe Valves: Copper piping up to and including 4", 200# WOG, solder joints.

3.6 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 150, bronze, nonmetallic, stainless-steel disc.
3. Ball Valves: Three piece, full port, bronze with bronze trim.
4. Bronze Swing Check Valves: Class 125, nonmetallic disc.
5. Bronze Gate Valves: Class 125.
6. Bronze Globe Valves: Class 125, nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron Gate Valves: Class 125, OS&Y.
7. Iron Globe Valves: Class 125.
8. Lubricated Plug Valves: Class 125, cylindrical, flanged.

3.7 WATER HAMMER ARRESTERS

- A. The Subcontractor shall furnish and install sufficient engineered piston type water hammer arresters through out the domestic water systems in accordance with the American Society of Sanitary Engineers (ASSE) standard for sizing and placement of water hammer arresters under ASSE 1010 certification. The water hammer arresters shall have sufficient volume of compressed gas within the system at flow pressure to absorb the shock energy and dissipate the kinetic energy generated within the domestic water systems. All water hammer arresters shall be installed in the vertical position. Engineered water hammer arresters shall be manufactured by Sioux Chief Mfg. Co. (Peculiar, MO), Josam, J.R. Smith or Zurn.

3.8 MAKE-UP WATER AND QUICK FILL CONNECTIONS

- A. Domestic water shall be connected to equipment as shown on the Drawings. Each of the systems requiring domestic water shall be provided with a manual quick fill, makeup water connection, in addition to the automatic feed connections. Makeup water piping shall be copper as specified herein for domestic hot and cold water piping up to the tap into the main system line.

END OF SECTION

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

B. Related sections:

1. Division 05 Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 22 Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
 - 6. Piping restraints for all storm and sanitary piping systems 3" and larger.
 - 7. Piping restraints for all vent piping at the base of sanitary and waste risers 3" and larger.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

D. No hub- Cast Iron Soil Pipe Fittings and Restraints

1. Manufacturers: Basis of Design product: subject to compliance with requirements provide Holdrite 117 series no hub fitting restraints or comparable manufacturer/product.
 - a. Holdrite.
 - b. Lock-rite.
 - c. EZ Strut
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Metallic Coating: Electroplated zinc, Hot-dipped galvanized, Mill galvanized, In-line, hot galvanized, Mechanically-deposited zinc.
8. Paint Coating: Vinyl, Vinyl alkyd, Epoxy, Polyester, Acrylic, Amine, Alkyd.
9. Plastic Coating: PVC, Polyurethane, Epoxy, Polyester.
10. Combination Coating

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Coating: Zinc, Paint, PVC.

2.4 FIBERGLASS STRUT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Allied Tube & Conduit.
 2. Champion Fiberglass, Inc.

3. Cooper B-Line, Inc.
4. SEASAFE, INC.; a Gibraltar Industries Company.

B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.

1. Channels: Continuous slotted fiberglass or other plastic channel with inturned lips.
2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade I polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade I polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.

4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- Q. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA I requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required and approved by structural engineer in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Aluminum or Brass.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.032-inch (0.8-mm) or Stainless steel, 0.025-inch (0.64-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Minimum Approximately 4 by 7 inches (100 by 178 mm).
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

- D. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories and ANSI Z535 - Safety Color Code - Environmental Facility Safety Signs - Criteria for Safety Symbols - Product Safety Sign & Labels - Accident Prevention Tags.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. All valves shall be provided with tags.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 220700
PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all insulation required for piping and equipment as indicated on and in accordance with the requirements of the Contract Documents.
- B. Section includes:
 - 1. Accessories.
 - 2. Adhesives and sealants.
 - 3. Pipe insulation.

1.2 RELATED SECTIONS

- A. Refer to Divisions 01, 14, 21, 23, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

1.3 REFERENCES

- A. All insulating products and accessories shall be designed, manufactured, tested and installed in accordance with the latest applicable codes and reference standards including, but not limited to, the following:
 - 1. Codes: Perform all work in accordance with the latest applicable codes and standards.
 - a. International Building Code.
 - b. International Plumbing Code.
 - 2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:

- a. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 - 1) ASHRAE 90.1: Energy Standard for Buildings except Low-Rise Residential Buildings.

- b. ASTM International
 - 1) ASTM B209: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2) ASTM C177: Standard Test Method for Steady-state Heat Flux Measurements and Thermal Transmission Properties by Means of Guarded-Hot-Plate Apparatus.
 - 3) ASTM C335: Standard Test Method for Steady-state Heat Transfer Properties of Horizontal Pipe Insulation.
 - 4) ASTM C411: Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - 5) ASTM C533: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 6) ASTM C547: Standard Specification for Mineral Fiber Pipe Insulation.
 - 7) ASTM C552: Standard Specification for Cellular Glass Thermal Insulation.
 - 8) ASTM C585: Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing.
 - 9) ASTM C612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 10) ASTM C871: Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate and Sodium Ions.
 - 11) ASTM C1136: Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 - 12) ASTM E84: Standard Test Methods for Surface Burning Characteristics of Building Materials.
 - 13) ASTM E96: Standard Test Methods for Water Vapor Transmission of Materials.

- c. Greenguard Environmental Institute
- d. Manufacturers Standardization Society of the Valve and Fittings Industry
 - 1) MSS SP 69: Pipe Hangers and Supports - Selection and Application.
 - 2) MSS SP 89: Pipe Hangers and Supports - Fabrication and Installation Practices.

- e. National Fire Protection Association (NFPA)
 - 1) NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials.
- f. Underwriters Laboratories, Inc.
 - 1) UL 723: Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the Conditions of the Contract, Division 01, and Section 220500 and shall include, but not be limited to:
 - 1. Schedule of materials indicating the type of system which it is installed, insulation type, insulation jacket, thickness for each pipe size and each type of equipment.
- B. Product Data: Submit manufacturer's literature including general assembly, for each type of product indicated. Include thermal conductivity, water-vapor permeance, thickness, and type of insulation jacket.
- C. Test Reports: Indicate procedures and results for specified factory and field acceptance testing and inspections.
- D. Manufacturer's Installation Instructions: Submit support details, installation instructions and connection requirements for the system.
 - 1. In addition, provide detailed installation procedures for the following:
 - a. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - b. Application of insulation at elbows, fittings, specialties and flanges for each type of insulation.
 - c. Application of field-applied jackets.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. The quality assurance requirements of Division 01 and Section 220500 shall apply to all work specified herein.
- B. All products and equipment specified herein shall be fabricated by companies whose primary business expertise is the manufacturing of commercial and industrial products and equipment with a minimum of ten (10) years documented experience.
- C. Each submittal shall be provided with documentation certifying that all materials, products, components and test reports are in compliance with the design requirements for this project.
- D. Make every effort to furnish all equipment of any equipment type from one manufacturer.
- E. Furnish all equipment, materials and accessories new and free from defects.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of Division 01 and Section 220500.
- B. Accept all material and equipment on site in factory packing. Inspect for damage. Comply with the manufacturer's rigging and installation instructions.
- C. Protect all components from physical damage, including effects of weather, water, and construction debris.
- D. Store tapes, adhesives, mastics, cements, and insulation materials in ambient conditions acceptable to and in accordance with the recommendations of the manufacturer.
- E. Store products and materials off floors on raised platforms to protect from water damage.
- F. Products and materials, which have been exposed to water damaged shall be replaced by the Contractor at no additional expense to the Contract.

1.7 WARRANTY

- A. Comply with the requirements of Division 01 and Section 220500.
- B. Furnish a one (1) year manufacturer's warranty for all insulation products.
- C. Warranty period shall commence upon final acceptance by the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the Contract Documents will be revised to reflect the substitution.
- C. Accessories:
 - 1. Buckaroos, Inc.
 - 2. Insul-Shield.
 - 3. Pipe Shields, Inc.
 - 4. Thermal Pipe Shields, Inc.
 - 5. Value Engineered Products, Inc.
- D. Adhesives and Sealants
 - 1. Benjamin Foster Company.
 - 2. Centiva.
 - 3. Duro Dyne.
 - 4. Elgen.
 - 5. ITW TACC.
- E. Equipment Insulation
 - 1. Certain Teed Corp.
 - 2. Johns-Manville.
 - 3. Knauf Insulation.
 - 4. Owens-Corning.

F. Pipe Insulation and PVC Covers

1. Certain Teed Corp.
2. Johns-Manville (Zeston).
3. Knauf Insulation.
4. Owens-Corning.
5. Proto Corporation.
6. Speedline Corporation.

2.2 GENERAL REQUIREMENTS

- A. All materials and equipment shall be new, in good condition and free from defect. The commercially standard items of equipment and the specific names mentioned herein are intended to identify standards of quality and performance necessary for the proper functioning of the work.
- B. Since manufacturing methods vary, reasonable minor variations are expected; however, performance and material requirements specified herein are the minimum standards acceptable. The Engineer retains the sole right to judge the equality of equipment that deviates from the Contract Documents, to reject any alternative submitted by the Contractor, and to require the specified materials and equipment, which conform to the requirements of the Contract Documents be furnished.
- C. Materials and equipment, which are found to have factory defects shall be replaced or repaired in a manner acceptable to the Owner and Engineer at no additional cost to the Owner. The Contractor shall be responsible for all costs associated with testing, replacement or repair, including but not limited to, all replacement or repair costs, preparations prior to testing, all testing costs, extended warranties, re-commissioning of the equipment, etc.
- D. Insulation materials furnished shall meet the minimum thickness requirements of ASHRAE Standard 90.1 - Energy Efficient Design of New Buildings.
- E. All thermal and acoustical insulation jackets, facings, membrane, adhesives, mastics, coatings and accessory materials shall be tested in compliance with the latest versions of ASTM E-84, MSS SP-69, NFPA 255 and/or UL 723 procedures.
- F. All materials shall comply with the requirements of NFPA 90A and shall be listed and labeled by Underwriters Laboratories, Inc. for a fire hazard classification, not to exceed the following:
 1. Insulation installed indoors: Flame Spread 25, Smoke Developed 50.
 2. Insulation installed outdoors: Flame Spread 75, Smoke Developed 150.

- G. The rating for insulation with factory-applied jackets or facings shall be on a composite basis of insulation, jacket or facing, and the adhesive used to adhere the jacket or facing to the insulation.
- H. Materials and products required for work of this section shall not contain asbestos, formaldehyde, lead, mercury or mercury compounds, polychlorinated biphenyls (PCB's) or other hazardous materials.
- I. All insulation shall contain a minimum of 50% post-consumer recycled material.
- J. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 parts per million (ppm) when tested according to ASTM C 871.
- K. Insulation for fittings, valves, flanges, and accessories shall maintain the same thermal conductivity as the adjacent pipe insulation.
- L. Shipping containers for insulation and accessory materials shall be labeled to indicate conformance to the fire hazard classification.
- M. All vapor barriers shall be completely sealed against moisture penetration.

2.3 ACCESSORIES

- A. Pipe protection saddles shall be formed from carbon steel, 1/8 in. (3 mm) minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 in. (305 mm) shall have a center support rib.
- B. Pre-insulated shields shall be 180 degree, 18 gauge minimum galvanized sheet metal with high density water repellent Kaylo insulation, foam glass or high-density polyisocyanurate inserts minimum thickness to match outside diameter of the insulated pipe.
- C. Pre-insulated shields shall be no less than the following lengths:

Pipe Size	Shield Length
3/4 in. to 2-1/2 in. (63.5 mm to 19 mm)	10 in. (254 mm)
3 in. to 6 in. (150 mm to 75 mm)	12 in. (305 mm)
8 in. to 10 in. (254 mm to 203 mm)	16 in. (405 mm)
12 in. (305 mm) and over	22 in. (555 mm)

2.4 ADHESIVES AND SEALANTS

- A. Provide adhesives and sealants conforming to the requirements of ASTM C 916, ASTM E 84 and UL 273.
- B. Adhesives and sealants shall be listed and labeled by Underwriters Laboratories, Inc. for a fire hazard classification, not to exceed the following:
 - 1. Flame Spread 25
 - 2. Fuel Contribution 50
 - 3. Smoke Developed 50

2.5 EQUIPMENT INSULATION

- A. Equipment insulation shall be:
 - 1. 2 in. (50 mm) thick, 6 lbs/cu.ft. (96 kg/m³) density, fiber glass, rigid insulation board with white Kraft, fiber glass, aluminum foil laminate, All-Service Jacket (ASJ).
- B. Bring edges of insulation boards on tanks into firm contact and cut or score where necessary to fit the shape and contour of the vessel. Fill all voids in the insulation with insulating cement.
- C. Hold insulation in place with 1/2 in. (13 mm) wide, 25 gauge galvanized steel bands on not more than 12 in. (305 mm) centers. When insulation has been installed, apply a flooding brush coat of Benjamin Foster 30-36, or as approved, to the entire surface.
- D. Into the wet coating embed one layer of open weave glass cloth smoothed out in wallpapering manner to avoid wrinkles and holidays, and overlap at all fabric seams to a minimum of 2 in. (50 mm.) Apply a final finish coat of BF 30-36, or as approved.
- E. Equipment insulation shall be furnished and installed in accordance with the following schedule:

Service	Thickness - Type
Hot Water Heaters	2 in. (50 mm) thick, 6 lb. (96 kg) density, fiber glass, rigid board with All-Service Jacket (ASJ).
Cold Water Pneumatic Tanks	2 in. (50 mm) thick, 6 lb. (96 kg) density, fiber glass, rigid board with All-Service Jacket (ASJ).
Cold Water and Hot Water Meters	2 in. (50 mm) thick, 6 lb. (96 kg) density, fiber glass, with foil facings sealed and tied with copper-

Service	Thickness - Type
	plated annealed steel wire, a smooth coat of cement with an open weave glass cloth jacket applied with BF 30-35 adhesive.

2.6 PIPE INSULATION

- A. Pipe insulation shall be molded fiber glass one-piece insulation with white Kraft, fiber glass reinforced, and aluminum foil laminated, All-Service Jacket (ASJ). Pipe insulation shall be capable of continuous service at a pipe temperature of 450°F (232° C) without oxidation or burnout of binders or the development of odors or smoke by any constituent of the material. Physical characteristics shall be as follows:
 - 1. Minimum Density: 4 lbs/cu.ft. (64 kg/cu.m).
 - 2. Thermal Conductivity: 0.23 Btu-in./hr/ft² /°F (0.033 W/m at 24°C).
 - 3. Maximum Service Temperature: 850°F (454°C).
 - 4. Jacket Vapor Permeability: 0.02 perms.
 - 5. Jacket Puncture Resistance: 50 units (Beach).

- B. Pipe fittings and valves shall be insulated with pre-molded fiber glass sections and pre-molded thermoplastic covers for the sizes manufactured. For other types and sizes, fittings and valves shall be insulated with radially mitered segments of pipe covering secured in place with 16 gauge copper-plated, annealed steel wire. Pre-molded (PVC) fitting covers shall be suitable for same service temperature as pipe insulation.

- C. Install a vapor barrier on fittings, valves and flanges consisting of open weave glass cloth applied with BF 30-35 adhesive and finished with a flooding brush coat of the same adhesive.

- D. Insulation exposed to weather shall be provided with a weatherproof jacket of corrugated aluminum with a 3 in. lap that will shed water. Fittings, valves and flanges shall be weatherproofed with a weatherproof mastic reinforced with a glass cloth membrane and further coated with mastic.

- E. All lavatories, including, but not limited to, the Core Toilet Rooms, Break Rooms, Locker Rooms and other areas within the building, shall be provided with ADA-compliant under-sink pipe covers as manufactured by TRUEBRO Ips Corp. "Lav Guard 2 E-Z Series" waste and supply covers Model No. 102 E-Z or 402W "original" series.

- F. Insulation for piping systems shall be furnished and installed in accordance with the following schedule:

Service	Pipe Size	Temp	Thickness
Cold Water Mains and Branches	1-1/4 in. (32 mm) and below	450°F (232°C)	1 in. (25 mm)
Cold Water Mains and Branches	1-1/2 in. (38 mm) and above	450°F (232°C)	1 in. (25 mm)
Cold Water Risers (including pump discharge)	All	450°F (232°C)	1 in. (25 mm)
Cold Water Fixture Branches (in pipe spaces and above ceilings)	1-1/4 in. (32 mm) and below	450°F (232°C)	1/2 in. (13 mm)
Cold Water Fixture Branches (in pipe spaces and above ceilings)	1-1/2 in. (38 mm) and above	450°F (232°C)	1 in. (25 mm)
Cold Water Fixture Branches (exposed)	1-1/4 in. (32 mm) and below	450°F (232°C)	1/2 in. (13 mm)
Cold Water Fixture Branches (exposed)	1-1/2 in. (38 mm) and above	450°F (232°C)	1 in. (25 mm)
Chilled Drinking Water Piping	1-1/4 in. (32 mm) and below	450°F (232°C)	1/2 in. (13 mm)
Hot Water and Hot Water Circulation Mains and Branches	1-1/4 in. (32 mm) and below	450°F (232°C)	1 in. (25 mm)
Hot Water and Hot Water Circulation Mains and Branches	1-1/2 in. (38 mm) and above	450°F (232°C)	1-1/2 in. (38 mm)
Hot Water and Hot Water Circulation Risers	All	450°F (232°C)	1-1/2 in. (38 mm)
Hot Water and Hot Water Circulation Fixture Branches (in pipe spaces and above ceilings)	1-1/4 in. (32 mm) and below	450°F (232°C)	1 in. (25 mm)
Hot Water and Hot Water Circulation Fixture Branches (in pipe spaces and above ceilings)	1-1/2 in. (38 mm) and above	450°F (232°C)	1-1/2 in. (38 mm)
Hot Water and Hot Water Circulation Fixture Branches (exposed)	1-1/4 in. (32 mm) and below	450°F (232°C)	1 in. (25 mm)
Hot Water and Hot Water Circulation Fixture Branches (exposed)	1-1/2 in. (38 mm) and above	450°F (232°C)	1-1/2 in. (38 mm)

Service	Pipe Size	Temp	Thickness
Pre-Heated Hot Water Piping	All	450°F (232°C)	1-1/2 in. (38 mm)
Horizontal Waste (from chilled water drinking fountains, including vertical rise to fixture)	All	450°F (232°C)	1/2 in. (13 mm)
Horizontal Leader, Sanitary and Waste (over conference rooms and private offices)	All	450°F (232°C)	1/2 in. (13 mm)
Horizontal Storm Drains (including vertical stub to roof drains, including the entire roof drain body and trim to the underside of building structure)	All	450°F (232°C)	1/2 in. (13 mm)
Horizontal Drains Serving Humidifiers and Cooling Coil Condensate	All	450°F (232°C)	1/2 in. (13 mm)
Cold and Hot Water Mains and Branches (Subject to Freezing)	All	450°F (232°C)	2 in. (50 mm)
Sanitary Traps and piping (Subject to Freezing)	All	450°F (232°C)	2 in. (50 mm)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Accept all materials and equipment in factory packaging and examine for visible damage. All damaged material and equipment shall be removed from the job site and replaced by the manufacturer.

3.2 INSTALLATION

- A. Installation of all insulation, pre-molded fiber glass insulation and thermoplastic covers for fittings and the use of adhesives and sealants shall be in accordance with the manufacturer's recommendations and the Authorities Having Jurisdiction.

- B. Before applying insulation, all surfaces shall be free of dust, grease and foreign matter. Insulation shall not be applied to any piping and equipment until required pressure testing has been completed and the system approved for tightness.
- C. Where a vapor seal must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor retarder
- D. All pipe insulation shall be continuous through walls, ceiling and/or floor openings
- E. Install multiple layers of insulation with longitudinal and circumferential joints staggered.
- F. Pipe Insulation:
 - 1. Pipe insulation sections shall be firmly butted together at all joints with jacket laps and joint butt strips pulled tight and smooth. Longitudinal joints shall have a minimum 2 in. (50 mm) overlap. Butt joint strips shall be a minimum of 3 in. (75 mm) wide.
 - 2. Insulation for fittings, valves, flanges, and accessories shall maintain the same thermal conductivity as the adjacent pipe insulation.
 - 3. Valves, expansion joints and other specialties requiring periodic servicing or inspection shall be insulated with factory fabricated removable and reusable covers.
 - 4. Flanges shall be insulated with built-up sleeves of pipe covering overlapping the adjacent pipe insulation.
 - 5. Insulated piping exposed to weather in freezing climates, including fittings, flanges and valves, which are exposed to weather or freezing or called to be weatherproofed or freeze-protected shall be provided with an additional 2 in. (50 mm) of fiber glass insulation and shall be covered with a 30 mil (0.8 mm) thick UV resistant thermoplastic jacket with solvent-welded seams or 16 mil (0.4 mm) embossed aluminum jacket with all seams caulked. The completed installation shall form a completely monolithic system preventing the entrance of water.
- G. Piping within mechanical equipment rooms, in addition to the insulation and jacket specified, all piping, including fittings, flanges and valves, shall be covered with a 30 mil (0.8 mm) thick thermoplastic jacket.
- H. Hot service piping shall be insulated in accordance with the following:
 - 1. Insulation jacket laps and joint butt strips shall be taped on 4 in. (100 mm) centers with flare-type staples and secured with aluminum bands on 18 in. (380 mm) centers with one band over each joint butt strip.

2. Voids around fittings and valves and at flanges shall be filled with insulation and covered with premolded thermoplastic covers.
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems.
4. Insulation on hot pipes smaller than 4 in. (100 mm) shall be supported on factory-assembled thermal protection shields.

I. Cold service piping shall be insulated in accordance with the following:

1. Insulation jacket laps and joint butt strip shall be sealed with lap-sealing adhesive. At all fittings, valves and at intervals of every 5 sections of straight run pipe insulation, apply a vapor barrier coating, 1/16 in. (1.7 mm) thick, to all butt joints and on the bore of the pipe insulation for a minimum of 2 in. (50 mm) from the joint. Position insulation and press firmly into place, making certain that a complete unbroken seal is obtained.
2. Insulation shall be protected from hangers by a 180 degree galvanized steel shield on the outside of the insulation and vapor barrier. A half-section of waterproof, high-density insulation of the same thickness as the pipe insulation, and full length of the shield, shall be used to support the weight of the pipe at the shield. Factory-assembled thermal protection shields may also be used.

J. Equipment Insulation:

1. Insulation shall be cut, scored and mitered to fit contour of equipment and secured with weld pins and speed washers on 12 in. (305 mm) centers maximum.
2. Pins shall not be more than 3 in. (75 mm) from insulation joints or corners.
3. Seal all joints on heat exchangers, hot water heaters, hot water pre-heaters with 4 in. (100 mm) wide self-sealing ASJ tape.

3.3 CLEANING

- A. Before final adjustments are made and before operation of equipment, clean and remove all accumulation of dirt, chips or other deleterious material. Leave all insulation in suitable condition, before final acceptance.
- B. Touch-up, repair or replace damaged insulation, insulation jackets and vapor barriers before final acceptance.

3.4 ADJUSTING AND BALANCING

- A. Upon completion of insulation, hangers for piping, and supports for equipment shall be adjusted to ensure that the loads are distributed evenly and that there are no loads imposed by the piping and equipment on the insulation that it is provided with.

END OF SECTION

SECTION 220800

COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. This Section includes general requirements that apply to implementation of the commissioning process without regard to specific systems, assemblies, and components.
- B. Related Sections include the following:
 - 1. Division 01 Section 019113 General Commissioning Requirements for general commissioning process activities.
 - 2. Division 22 – Plumbing.

1.3 DEFINITIONS

- A. Commissioning Plan: A document, prepared by CxA, that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process. This Plan is included in Volume 4 of these specifications.
- B. CxA: Commissioning Authority.
- C. Quality Assurance: A program for the systematic monitoring and evaluation of the various aspects of a system, assembly, or component to ensure that standards of quality are being met. This is the responsibility of the CxA.

- D. Quality Control: A system for ensuring the maintenance of proper standards in systems, assemblies, and components. This is the responsibility of the Contractor.
- E. Official: State or Local official having jurisdiction over the conveying systems.
- F. Systems, Assemblies, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, equipment, and components.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. The CxA shall provide Construction Checklists to the Contractors for execution that will indicate expected Quality Control features required for a highest-quality installation. The contractor shall complete the checklists as construction progresses and return them to the CxA as indicated in Section 01 9113 General Commissioning Requirements.
- B. Checklists for this section will include:
 - 1. Sump and Sewage ejectors.
- C. A sample installation checklist is included to show the typical scope and rigor of the process.

3.2 PREREQUISITES TO TESTING

- A. Prior to the testing of these systems or assemblies, the Contractor shall certify that:
 - 1. The system or assembly is completely installed, functional, and documented.
 - 2. Work performed by other trades, but essential for this system or assembly's operation, is complete (e.g., electrical components are wired and power is provided).
 - 3. All contractor-performed start-up procedures and Pre-Functional Tests are complete and documented.
 - 4. The system or assembly is ready for the Owner to take beneficial use.

3.3 SYSTEM OR ASSEMBLY TEST REQUIREMENTS

- A. The CxA will provide Functional Performance Test procedures to the Contractor for execution for the following specific systems, assemblies and components:
1. Backflow Preventors fire and water.
 2. Domestic Cold water pumping system.
 3. Domestic master P.R.V's.
 4. Domestic Hot Water Systems.
 5. Domestic Hot Water Heaters.
 6. Thermostatic Mixing Valves.
 7. Domestic Hot Water Recirculation system.
 8. Heat Trace systems for piping – Greasy waste, heat maintenance, freeze protection.
 9. Central Chemical Treatment systems.
 10. Sump and Sewage ejectors.
 11. Vacuum Pump System for Laboratories
 12. Gas systems and emergency shutdown for laboratories
 13. Gas Booster system.
 14. Review Installation Checks with Specifications.
- B. Acceptance criteria and test details will be in accordance with the related sections including the following:
1. Division 01 Section 019113 General Commissioning Requirements for general commissioning process activities.
 2. Division 22 – Plumbing.
- C. A sample functional performance test is included to show the typical scope and rigor of the process.

3.4 TEST REPORTS

- A. Provide copies of all reports required in the listed reference sections (see Section 1.2 SUMMARY above for the sections) for review.

3.5 SAMPLE FORMS

**Sample Installation Checklist
General Plumbing Pipe Installation**

Schedule ID# from drawings: Piping System: _____ Location: _____

Reference Specification:

Reference Drawing:

Model Verification

	Specified	Submitted	Installed
Construction Standards	Miscellaneous		

Installation Checks

ID	Description	Pass/Fail	Comments
1	Water Piping: 1. Below ground water service piping 4" and larger shall be cement lined ductile iron pipe and fittings. 2. Above ground potable and non-potable water systems: ½"-4" Type L copper tubing with soldered joints.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
2	Gas Piping: 1. Aboveground exterior and interior gas and vents shall be schedule 40 steel pipe. 2. Fittings 2½" and less shall be screwed type for 3" and larger shall be welded.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
3	Verify sleeves are installed for pipes passing through concrete walls or floors, ½" air space around pipe to sleeve and sealed to make smoke/fire proof.	<input type="checkbox"/> <input type="checkbox"/>	
4	Verify that proper provisions for expansion and contraction of the hot water piping systems are provided by means of pipe bends, pipe offsets, swing connections or changes in direction of piping.	<input type="checkbox"/> <input type="checkbox"/>	

5	Verify that hose and drain valves are provided for complete draining of the system.	<input type="checkbox"/> <input type="checkbox"/>	
6	Verify that all high points in closed water piping systems have either equipment venting or manual vents installed.	<input type="checkbox"/> <input type="checkbox"/>	
7	<p>Natural Gas Piping:</p> <ol style="list-style-type: none"> 1. Verify piping pitches to drains at drip legs at least 6" long. 2. Verify shutoff valve is installed at each equipment connection on the downstream side of any regulators and installed in accessible location. 3. Piping is securely fastened, separately hung and not strapped or supporting other devices. 	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
8	<p>Identification:</p> <ol style="list-style-type: none"> 1. Verify color coded piping identification markers on piping systems are installed including flow direction markings: Identify equipment such as pumps, compressors, water heaters, and tanks with names and equipment numbers. 	<input type="checkbox"/> <input type="checkbox"/>	
9	<p>Verify Plumbing piping, fittings, and valves</p> <p>Insulation: All interior water piping.</p>	<input type="checkbox"/> <input type="checkbox"/>	

Approvals (Only One Required)

	Name (Printed Neatly)	Signature	Date
Contractor/Manuf. Rep.			

Engineer			
Construction Administrator			
Commissioning Agent			

**Sample Functional Performance Test
 Domestic Hot Water Heaters**

1. Participants

Name/Representing	Participation (Testing, Witness, etc.)
	Owner's Representative

Party filling out this form _____ Date of Test _____

2. Prerequisite Checklist

- An "as-built" version of the plumbing drawing has been provided.
- The plumbing contractor has certified that their internal commissioning is complete and the project is ready for third-party verification.
 PC initials: _____ Date: _____
- The general contractor has certified that the construction is substantially complete and ready for third-party verification.
 GC initials: _____ Date: _____

Parameter	Pre-Test Values	Returned to Pre-Test Values <input checked="" type="checkbox"/>
Domestic HW Temperature SP, °F		<input type="checkbox"/>

Domestic HW Pressure Set Point, psig		<input type="checkbox"/>
Mixing Valve Position Control, Auto/Manual		<input type="checkbox"/>

3. **Sensor Calibration Checks.** The sensors listed below are to be checked for calibration and adequate location.

Sensor	Location OK ¹	BAS Value	Measured Value	Pass Y/N
Domestic HW Temperature, °F	Y / N			Y / N
Domestic HW Pressure, psig	Y / N			Y / N
	Y / N			Y / N

4. **Device Calibration Checks.** The actuators or devices listed below are to be checked for proper operation and/or calibration.

Device or Actuator	Procedure / State	BAS Value	Site Observation	Pass Y / N
Mixing Valve Command	0% Open			Y / N
	50% Open			Y / N
	100% Open			Y / N

5. **Functional Testing Procedures**

Floor	Location/ Heater	Test Procedure	Expected Results	Pass/Fail	Notes
All	Test Water Temperature	1. Operate each faucet and verify water temperature and that hot water is piped properly for left side flow. 2. Measure hot water temperature at each sink and lavatory. 3. Restore system	1. Temperature should range between 110-120 degrees. 2. Everything should operate and drain. Automatic flush valves should not cause splashing, hot water should be on the left, cold on the right. 3. The system should resume normal operation.	Y / N	

		to normal.			
MER	Penthouse	Repeat Process #1 - #3	Repeat Process #1 - #3	Y / N	
G		Repeat Process #1 - #3	Repeat Process #1 - #3	Y / N	
1		Repeat Process #1 - #3	Repeat Process #1 - #3	Y / N	
2		Repeat Process #1 - #3	Repeat Process #1 - #3	Y / N	
3		Repeat Process #1 - #3	Repeat Process #1 - #3	Y / N	

-- END OF TEST --

END OF SECTION

SECTION 221116
DOMESTIC WATER PIPING

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.
- B. Vibration and noise criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Testing Adjusting and Balancing for Plumbing section 220593.
- D. VOC Limits for Adhesives, Sealants, Paints and Coatings Section 018101
- E. Construction and Demolition Waste Management Section 018102
- F. Construction and Demolition Waste Management Section 018102

1.2 SUMMARY

- A. Section includes:
 - 1. Copper tube and fittings.
 - 2. Ductile-iron pipe and fittings.
 - 3. PEX tube and fittings.
 - 4. Piping joining materials.
 - 5. Transition fittings.
 - 6. Dielectric fittings.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.

2. Transition fittings.
 3. Dielectric fittings.
 4. Flexible connectors.
 5. Water meters.
 6. Backflow preventers, Vacuum breakers, Backflow preventers, and vacuum breakers.
 7. Water penetration systems.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Fire-suppression-water piping.
 2. Domestic water piping.
 3. Compressed air piping.
 4. HVAC hydronic piping.
- D. Field quality-control reports.
- 1.4 QUALITY ASSURANCE
- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.
- 1.5 PROJECT CONDITIONS
- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
1. Notify Architect and Construction Manager no fewer than 5 days in advance of proposed interruption of water service.
 2. Do not proceed with interruption of water service without Architect's and Construction Manager's written permission.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. All copper tubes shall be manufactured in the United States.
 - 2. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 3. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 5. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Soft Copper Tube: ASTM B 88, Type M water tube, annealed temper (to be used on Refrigerator domestic water connection only).
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Elkhart Products Corporation; Industrial Division.
 - 2. NIBCO INC.
 - 3. Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

- c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PEX TUBE AND FITTINGS

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a) Elkhart Products Corporation; Industrial Division.
 - b) NIBCO INC.
 - c) Viega; Plumbing and Heating Systems.
- B. Tube Material: PEX plastic according to ASTM F876 and ASTM F877.
- C. Fittings: ASTM F1807, metal insert and copper crimp rings.
- D. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

2.4 DUCTILE-IRON PIPE AND FITTINGS (Buried Piping)

- A. Mechanical-Joint, Ductile-Iron Pipe:
 - 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
 - 1. AWWA C110/A21.10, ductile or gray iron.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
 - 1. AWWA C153/A21.53, ductile iron.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.6 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Sheet or Tube.
- C. Material: High-density, cross-laminated PE film of 0.004-inch minimum thickness.
- D. Color: Black or Natural.

2.7 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.8 TRANSITION FITTINGS

- A. General Requirements:

1. Same size as pipes to be joined.
 2. Pressure rating at least equal to pipes to be joined.
 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc; a Sensus company.
 - g. Viking Johnson; c/o Mueller Co.

2.9 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
 2. Description:

- a. Pressure Rating: 250 psig at 180 deg F.
- b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 175 psig minimum.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Description:
 - a. Non-conducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.10 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 1. Flex-Hose Co., Inc.
 2. Flexicraft Industries.
 3. Flex Pression, Ltd.
 4. Flex-Weld, Inc.

5. Hyspan Precision Products, Inc.
 6. Mercer Rubber Co.
 7. Metraflex, Inc.
 8. Proco Products, Inc.
 9. Tozen Corporation.
 10. Unaflex, Inc.
 11. Universal Metal Hose; a Hyspan company
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 250 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 250 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.11 WATER METERS

- A. Displacement-Type Water Meters:
1. All water meters shall be as approved by Westchester County Department of Environmental Protection – Bureau of Water Supply. Provide with approved Automated meter reading devices.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water and fire line service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level with 0.25 percent slope downward toward drain without pitch and plumb.
- I. Rough-in domestic water piping for water-meter and backflow devices installation according to approved DEP applications drawings and requirements.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping adjacent to equipment and specialties to allow service and maintenance.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install PEX tubing with loop at each change of direction of more than 90 degrees.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- U. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- V. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2144. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- I. Joints for PEX Tubing: Join according to ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. See detail on drawing. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings nipples or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump where not provided as part of water booster system.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.

- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 WATER METER INSTALLATION TESTING

- A. Rough-in domestic water piping for water meter installation.
- B. Water meters will be furnished and installed by this sub-contractor.
- C. Water meters installed shall include all appurtenances, wiring and remote meter transmitters as required for compliance with governing authority

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.

7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install vinyl-coated hangers for PEX tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.

G. Install hangers for vertical PEX tubing every 48 inches (1200 mm).

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.

2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 1½ times operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for one hour. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.

3.12 ADJUSTING

- A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.13 CLEANING

- A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 1. Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 2. Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Aboveground domestic water piping, NPS 4" and smaller, shall be one of the following:
 1. Hard copper tube, Type K ASTM B88M; wrought- copper solder-joint fittings; and soldered joints.
 2. PEX tube, NPS 1 (DN 25) and smaller.
 - a. Fittings for PEX tube:
 1. ASTM F1807, metal insert and copper crimp rings.
 2. ASTM F1960, cold expansion fittings and reinforcing rings.

3. ASSE 1061, push-fit fittings.

3.15 VALVE SCHEDULE

- A. Refer to section 220523 for general duty valves. For plumbing systems refer to section 221119 for domestic water piping specialties.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

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. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Outlet boxes.
 - 8. Hose stations.
 - 9. Hose bibbs.
 - 10. Wall hydrants.
 - 11. Ground hydrants.
 - 12. Post hydrants.
 - 13. Drain valves.
 - 14. Water hammer arresters.
 - 15. Air vents.
 - 16. Trap-seal primer valves.
 - 17. Trap-seal primer systems.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 22 Section "Domestic Water Piping" for water meters.

3. Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Division 22 Section "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
6. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.
7. Finish: [Rough bronze] [Chrome plated].

B. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.

- i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1011.
 4. Body: Bronze, nonremovable, with manual drain.
 5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 6. Finish: [Chrome or nickel plated] [Rough bronze].

C. Pressure Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1020.
4. Operation: Continuous-pressure applications.
5. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
6. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Honeywell Water Controls.
 - e. Legend Valve.

- f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1012.
 4. Operation: Continuous-pressure applications.
 5. Body: Bronze.
 6. End Connections: [Union, solder] joint.
 7. Finish: [Rough bronze].

B. Reduced-Pressure-Principle Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1013.
4. Operation: Continuous-pressure applications.
5. Pressure Loss: [8 psig] <Insert pressure> maximum, through middle 1/3 of flow range.
6. Body: Bronze for NPS 2 and smaller; [cast iron with interior lining complying with AWWA C550 or that is FDA approved] [steel with interior lining complying with AWWA C550 or that is FDA approved] [stainless steel] for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; [flanged] for NPS 2-1/2 and larger.
8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1015.
4. Operation: Continuous-pressure applications, unless otherwise indicated.
5. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
6. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

D. Beverage-Dispensing-Equipment Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1022.
4. Operation: Continuous-pressure applications.
5. Size: NPS 1/4 or NPS 3/8.
6. Body: Stainless steel.
7. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Ford Meter Box Company, Inc. (The).
 - f. Honeywell Water Controls.
 - g. Legend Valve.
 - h. McDonald, A. Y. Mfg. Co.
 - i. Mueller Co.; Water Products Div.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1024.
 4. Operation: Continuous-pressure applications.
 5. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Lancer Corporation.
 - c. Watts Industries, Inc.; Water Products Div.
3. Standard: ASSE 1032.
4. Operation: Continuous-pressure applications.
5. Size: NPS 1/4 or NPS 3/8.
6. Body: Stainless steel.
7. End Connections: Threaded.

G. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.

- c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1047 and FMG approved or UL listed.
 4. Operation: Continuous-pressure applications.
 5. Pressure Loss: 10 psig maximum, through middle 1/3 of flow range.
 6. End Connections: Flanged.
 7. Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A 112.1.2, matching backflow-preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer. Subject to local water supplier requirements.

H. Double-Check, Detector-Assembly Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1048 and FMG approved or UL listed.
4. Operation: Continuous-pressure applications.
5. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
6. Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

I. Hose-Connection Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:

2. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
3. **Standard:** ASSE 1052.
4. **Operation:** Up to 10-foot head of water back pressure.
5. **Inlet Size:** NPS 1/2 or NPS 3/4.
6. **Outlet Size:** Garden-hose thread complying with ASME B1.20.7.
7. **Capacity:** At least 3-gpm flow.

J. Backflow-Preventer Test Kits:

1. **Available Manufacturers:** Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
3. **Description:** Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. **Available Manufacturers:** Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Industries, Inc.; Water Products Div.

- e. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig.
5. Size: As indicated on drawings.
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CLA-VAL Automatic Control Valves.
 - b. Flomatic Corporation.
 - c. OCV Control Valves.
 - d. Watts Industries, Inc.; Ames Fluid Control Systems.
 - e. Watts Industries, Inc.; Watts ACV.
 - f. Zurn Plumbing Products Group; Wilkins Div.
3. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
4. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
5. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.

- d. NIBCO INC.
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
3. Type: Ball valve with two readout ports and memory setting indicator.
 4. Body: Bronze
 5. Size: Same as connected piping, but not larger than NPS 2.
 6. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Cast-Iron Calibrated Balancing Valves:**
1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Watts Industries, Inc.; Water Products Div.
 3. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
 4. Size: Same as connected piping, but not smaller than NPS 2-1/2.
- C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.**
- D. Memory-Stop Balancing Valves:**
1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.

- f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
- 3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 - 4. Pressure Rating: 400-psig minimum CWP.
 - 5. Size: NPS 2 or smaller.
 - 6. Body: Copper alloy.
 - 7. Port: Standard or full port.
 - 8. Ball: Chrome-plated brass.
 - 9. Seats and Seals: Replaceable.
 - 10. End Connections: Solder joint or threaded.
 - 11. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a Watts Industries Co.
 - h. Symmons Industries, Inc.
 - i. Taco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group; Wilkins Div.
- 3. Standard: ASSE 1017.
- 4. Pressure Rating: 125 psig.
- 5. Type: Thermostatically controlled water mixing valve.
- 6. Material: Bronze body with corrosion-resistant interior components.
- 7. Connections: Threaded[union] inlets and outlet.

8. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
9. Tempered-Water Setting: <Insert deg F.>
10. Tempered-Water Design Flow Rate: <Insert gpm.>
11. Valve Finish: [Chrome plated] [Rough bronze].

B. Primary, Thermostatic, Water Mixing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Symmons Industries, Inc.
3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Type: [Exposed-mounting] [Cabinet-type], thermostatically controlled water mixing valve.
6. Material: Bronze body with corrosion-resistant interior components.
7. Connections: Threaded[union] inlets and outlet.
8. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
9. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
10. Tempered-Water Setting: <Insert deg F.>
11. Tempered-Water Design Flow Rate: <Insert gpm.>
12. Selected Valve Flow Rate at 45-psig Pressure Drop: <Insert gpm.>
13. Pressure Drop at Design Flow Rate: <Insert psig.>
14. Valve Finish: [Chrome plated] [Polished, chrome plated] [Rough bronze].
15. Piping Finish: [Chrome plated] [Copper].
16. Cabinet: Factory-fabricated, stainless steel, for [recessed] [surface] mounting and with hinged, stainless-steel door.

C. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Leonard Valve Company.
 - b. Powers; a Watts Industries Co.
 - c. Symmons Industries, Inc.
3. Description: Factory-fabricated, [cabinet-type] [exposed-mounting], thermostatically controlled, water-mixing-valve assembly in [two] [three]-valve parallel arrangement.
4. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
5. Intermediate-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
6. Small-Flow Parallel: Thermostatic water mixing valve.
7. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
8. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
9. Component Pressure Ratings: 125 psig minimum, unless otherwise indicated.
10. Cabinet: Factory-fabricated, stainless steel, for [recessed] [surface] mounting and with hinged, stainless-steel door.
11. Selected Large Flow, Tempered Water Valve Size: <Insert size.>
12. Tempered-Water Setting: <Insert deg F.>
13. Unit Tempered-Water Design Flow Rate: <Insert gpm.>
14. Unit Minimum Tempered-Water Design Flow Rate: <Insert gpm.>
15. Selected Unit Flow Rate at 45-psig Pressure Drop: <Insert gpm.>
16. Unit Pressure Drop at Design Flow Rate: <Insert psig.>
17. Unit Tempered-Water Outlet Size: <Insert NPS> end connection.
18. Unit Hot- and Cold-Water Inlet Size: <Insert NPS> end connections.
19. Thermostatic Mixing Valve and Water Regulator Finish: [Chrome plated] [Polished, chrome plated] [Rough bronze].
20. Piping Finish: [Chrome plated] [Copper].

D. Photographic-Process, Thermostatic, Water-Mixing-Valve Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.

d. Symmons Industries, Inc.

3. Standard: ASSE 1017, thermostatically controlled water mixing valve made for precise, process-water temperature control.
4. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Body: Bronze with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, thermometer, shutoff valve, and adjustable, temperature-control handle.
8. Cabinet: Factory-fabricated, stainless steel, for surface mounting; with controls and thermometer mounted on front.
9. Tempered-Water Setting: <Insert deg F.>
10. Tempered-Water Design Flow Rate: <Insert gpm.>
11. Tempered-Water Outlet Size: <Insert NPS> end connection.
12. Hot- and Cold-Water Inlet Size: <Insert NPS> end connections.

E. Individual-Fixture, Water Tempering Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company.
 - f. Powers; a Watts Industries Co.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1016, thermostatically controlled water tempering valve.
4. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Body: Bronze body with corrosion-resistant interior components.
6. Temperature Control: Adjustable.
7. Inlets and Outlet: Threaded.
8. Finish: Rough or chrome-plated bronze.
9. Tempered-Water Setting: <Insert deg F.>
10. Tempered-Water Design Flow Rate: <Insert gpm.>

F. Primary Water Tempering Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Heat-Timer Corporation.
 - b. Holby Valve Co., Inc.
3. Standard: ASSE 1017, thermostatically controlled tempering valve, listed as tempering valve.
4. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Body: Bronze.
6. Temperature Control: Manual.
7. Inlets and Outlet: Threaded.
8. Selected Primary Water Tempering Valve Size: <Insert size.>
9. Tempered-Water Setting: <Insert deg F.>
10. Tempered-Water Design Flow Rate: <Insert gpm.>
11. Pressure Drop at Design Flow Rate: <Insert psig.>
12. Tempered-Water Outlet Size: <Insert NPS> end connection.
13. Cold-Water Inlet Size: <Insert NPS> end connection.
14. Hot-Water Inlet Size: <Insert NPS> end connection.
15. Valve Finish: [Rough bronze] <Insert finish>.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron [with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and] for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: [0.020 inch] [0.033 inch] [0.062 inch] <Insert size>.
 - b. Strainers NPS 2-1/2 to NPS 4: [0.045 inch] [0.062 inch] [0.125 inch] <Insert size>.
 - c. Strainers NPS 5 and Larger: [0.10 inch] [0.125 inch] [0.25 inch] <Insert size>.
6. Drain: [Pipe plug] [Factory-installed, hose-end drain valve].

2.7 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. LSP Products Group, Inc.
 - e. Oatey.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.
 - g. Symmons Industries, Inc.
 - h. Watts Industries, Inc.; Water Products Div.
 - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - j. Zurn Plumbing Products Group; Light Commercial Operation.
3. Mounting: Recessed.
4. Material and Finish: [Enameled-steel or epoxy-painted-steel] [Enameled-steel or epoxy-painted-steel or plastic] [Plastic] [Stainless-steel] box and faceplate.
5. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
6. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
7. Drain: [NPS 1-1/2] [NPS 2] standpipe and P-trap for direct waste connection to drainage piping.
8. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
9. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Acorn Engineering Company.
 - b. IPS Corporation.
 - c. LSP Products Group, Inc.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
3. Mounting: Recessed.
 4. Material and Finish: [Enameled-steel or epoxy-painted-steel] [Enameled-steel or epoxy-painted-steel or plastic] [Plastic] [Stainless-steel] box and faceplate.
 5. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
 6. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.8 HOSE STATIONS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ARCHON Industries, Inc.
 2. Armstrong International, Inc.
 3. Cooney Brothers, Inc.
 4. DynaFluid Ltd.
 5. Leonard Valve Company.
 6. Strahman Valves, Inc.
 7. T & S Brass and Bronze Works, Inc.
- C. Single-Temperature-Water Hose Stations:
 1. Standard: ASME A112.18.1.
 2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
 3. Hose-Rack Material: Stainless steel.
 4. Body Material: Bronze[with stainless-steel wetted parts].
 5. Body Finish: Rough bronze[, chrome plated].
 6. Mounting: [Wall, with reinforcement] [Floor, with stainless-steel pedestal].

7. Supply Fitting: [NPS 1/2] [NPS 3/4] gate, globe, or ball valve and check valve and [NPS 1/2] [NPS 3/4] copper, water tubing. Omit check valve if check stop is included with fitting.
8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; [25 feet] [50 feet] <Insert length> long.
9. Nozzle: With hand squeeze on-off control.
10. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

D. Hot- and Cold-Water Hose Stations:

1. Standard: ASME A112.18.1.
2. Type Faucet: [Blending] [Thermostatic mixing] valve.
3. Cabinet: Stainless-steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.
5. Body Material: Bronze[with stainless-steel wetted parts].
6. Body Finish: Rough bronze[or chrome plate].
7. Mounting: [Wall, with reinforcement] [Floor, with stainless-steel pedestal].
8. Supply Fittings: Two [NPS 1/2] [NPS 3/4] gate, globe, or ball valves and check valves and [NPS 1/2] [NPS 3/4] copper, water tubing. Omit check valves if check stops are included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; [25 feet] [50 feet] <Insert length> long.
10. Nozzle: With hand squeeze on-off control.
11. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

E. Cold-Water and Steam Hose Stations:

1. Standard: ASME A112.18.1.
2. Type Faucet: [Blending] [Thermostatic mixing] valve.
3. Cabinet: Stainless-steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.
5. Body Material: Bronze [with stainless-steel wetted parts].
6. Body Finish: Rough bronze [or chrome plate].
7. Mounting: [Wall, with reinforcement] [Floor, with stainless-steel pedestal].

8. Supply Fittings: Two [NPS 1/2] [NPS 3/4] gate, globe, or ball valves and check valves and [NPS 1/2] [NPS 3/4] copper, water tubing. Omit check valves if check stops are included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; [25 feet] [50 feet] <Insert length> long.
10. Nozzle: With hand squeeze on-off control.
11. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

2.9 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A 112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral[or field-installation,] nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: [Rough bronze] [Chrome or nickel plated].
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: [Wheel handle] [Operating key].
13. Operation for Finished Rooms: [Wheel handle] [Operating key].
14. Include operating key with each operating-key hose bibb.
15. Include[integral] wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.21.3M for [concealed] [exposed]-outlet, self-draining wall hydrants.
 4. Pressure Rating: 125 psig.
 5. Operation: Loose key.
 6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 7. Inlet: NPS 3/4 or NPS 1.
 8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 9. Box: Deep, flush mounting with cover.
 10. Box and Cover Finish: [Polished nickel bronze] [Chrome plated] <Insert finish>.
 11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 12. Nozzle and Wall-Plate Finish: [Polished nickel bronze] [Rough bronze] <Insert finish>.
 13. Operating Keys(s): [One] [Two] with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. Prier Products, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Woodford Manufacturing Company.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Standard: ASME A112.21.3M for [concealed] [exposed]-outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig.
5. Operation: Loose key.
6. Casings and Operating Rods: Of length required to match wall thickness. Include wall clamps.
7. Inlets: NPS 3/4 or NPS 1.
8. Outlet: Concealed.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: [Polished nickel bronze] [Chrome plated] <Insert finish>.
11. Vacuum Breaker: Nonremovable, manual-drain-type, hose-connection [vacuum breaker complying with ASSE 1011] [or] [backflow preventer complying with ASSE 1052] and with garden-hose thread complying with ASME B1.20.7 on outlet.
12. Operating Keys(s): [One] [Two] with each wall hydrant.

C. Moderate-Climate Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.21.3M for [concealed] [exposed]-outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig.
5. Operation: Loose key.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker or nonremovable hose-connection [vacuum breaker complying with ASSE 1011] [or] [backflow preventer complying with ASSE 1052]; and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: [Polished nickel bronze] [Chrome plated] <Insert finish>.

10. Outlet: Exposed, with integral vacuum breaker or nonremovable hose-connection [vacuum breaker complying with ASSE 1011] [or] [backflow preventer complying with ASSE 1052]; and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: [Polished nickel bronze] [Rough bronze] <Insert finish>.
12. Operating Keys(s): [One] [Two] with each wall hydrant.

D. Vacuum Breaker Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Mansfield Plumbing Products LLC.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Prier Products, Inc.
 - e. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
3. Standard: ASSE 1019, Type A or Type B.
4. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
5. Classification: [Type A, for automatic draining with hose removed or]Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
6. Pressure Rating: 125 psig.
7. Operation: [Loose key] [Loose key or wheel handle] [Wheel handle].
8. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
9. Inlet: NPS 1/2 or NPS 3/4.
10. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.11 GROUND HYDRANTS

A. Nonfreeze Ground Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Josam Company.
 - b. MIFAB, Inc.
 - c. Murdock, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.21.3M.
 4. Type: Nonfreeze, concealed-outlet ground hydrant with box.
 5. Operation: Loose key.
 6. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
 7. Inlet: NPS 3/4.
 8. Outlet: Garden-hose thread complying with ASME B1.20.7.
 9. Drain: Designed with hole to drain into ground when shut off.
 10. Box: [Standard] [Deep] pattern with cover.
 11. Box and Cover Finish: [Rough] [Polished nickel] <Insert finish> bronze.
 12. Operating Key(s): [One] [Two] with each ground hydrant.
 13. Vacuum Breaker: ASSE 1011.

2.12 POST HYDRANTS

A. Nonfreeze, Draining-Type Post Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. Prier Products, Inc.
 - c. Simmons Manufacturing Co.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.

- i. Zurn Plumbing Products Group; Specification Drainage Operation.
 3. Standard: ASME A112.21.3M.
 4. Type: Nonfreeze, exposed-outlet post hydrant.
 5. Operation: Loose key.
 6. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
 7. Casing: Bronze with casing guard.
 8. Inlet: NPS 3/4.
 9. Outlet: Garden-hose thread complying with ASME B1.20.7.
 10. Drain: Designed with hole to drain into ground when shut off.
 11. Vacuum Breaker: Nonremovable, drainable, hose-connection [vacuum breaker complying with ASSE 1011] [or] [backflow preventer complying with ASSE 1052]; and garden-hose thread complying with ASME B1.20.7 on outlet.
 12. Operating Key(s): [One] [Two] with each loose-key-operation wall hydrant.
- B. Nonfreeze, Nondraining-Type Post Hydrants:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Murdock, Inc.
 3. Operation: Lever-piston operating mechanism and nondraining water-storage reservoir, designed without drain
 4. Length: As required for burial of valve below frost line.
 5. Inlet: NPS 1 threaded.
 6. Outlet: [NPS 1 outlet and coupling plug for 1-inch hose] [NPS 1 by NPS 3/4 adapter with nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7 on outlet] [or] [NPS 1 by NPS 3/4 adapter with nonremovable, drainable, hose-connection backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet].
- C. Freeze-Resistant Sanitary Yard Hydrants:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hoeptner Products.

3. Standard: ASSE 1057, Type 5 for nondraining hydrants.
4. Operation: Wheel handle.
5. Head: Copper alloy, with pail hook.
6. Inlet: NPS 3/4-inch threaded inlet and inlet nozzle, galvanized-steel riser, and venturi.
7. Canister: [Plastic] [Zinc-plated steel] with atmospheric-vent device.
8. Vacuum Breaker: Removable hose-connection backflow preventer complying with ASSE 1052 with garden-hose thread complying with ASME B1.20.7 on outlet for field installation.

2.13 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.

5. Drain: NPS 1/8 side outlet with cap.

2.14 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: [Metal bellows] [Copper tube with piston].
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.15 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: [NPS 3/8] [NPS 1/2] minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.

4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.16 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
3. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
4. Size: NPS 1-1/4 minimum.
5. Material: Chrome-plated, cast brass.

2.17 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. PPP Inc.
3. Standard: ASSE 1044,
4. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
5. Cabinet: [Recessed] [Surface]-mounting steel box with stainless-steel cover.
6. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
7. Vacuum Breaker: ASSE 1001.
8. Number Outlets: [Four] [Six] [Eight].
9. Size Outlets: [NPS 1/2] [NPS 5/8].

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves[and bypass with memory-stop balancing valve]. Install pressure gages on inlet and outlet.

- D. Install water control valves with inlet and outlet shutoff valves [and bypass with globe valve]. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each [control valve,] [water pressure-reducing valve,] [solenoid valve,] [and pump].
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install shutoff valve on outlet if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- J. Install ground hydrants with [1 cu. yd.] <Insert dimension> of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- K. Install draining-type post hydrants with [1 cu. yd.] <Insert dimension> of crushed gravel around drain hole. Set post hydrants in concrete paving or in [1 cu. ft.] <Insert dimension> of concrete block at grade.
- L. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.
- M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.
- N. Install water hammer arresters in water piping according to PDI-WH 201.
- O. Install air vents at high points of water piping. [Install drain piping and discharge onto floor drain.]

- P. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- Q. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- R. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check backflow-prevention assemblies.
 - 5. Carbonated-beverage-machine backflow preventers.
 - 6. Dual-check-valve backflow preventers.
 - 7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
 - 8. Double-check, detector-assembly backflow preventers.
 - 9. Water pressure-reducing valves.
 - 10. Calibrated balancing valves.
 - 11. Primary, thermostatic, water mixing valves.
 - 12. Manifold, thermostatic, water-mixing-valve assemblies.
 - 13. Photographic-process, thermostatic, water-mixing-valve assemblies.
 - 14. Primary water tempering valves.
 - 15. Outlet boxes.

16. Hose stations.
17. Supply-type, trap-seal primer valves.
18. Trap-seal primer systems.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 1. Test each [pressure vacuum breaker] [reduced-pressure-principle backflow preventer] [double-check backflow-prevention assembly] [and] [double-check, detector-assembly backflow preventer] <Insert type> according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 221316

SANITARY STORM, WASTE AND VENT PIPING

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. Pipe, tube, and fittings.
- 2. Specialty pipe fittings.
- 3. Encasement for underground metal piping.

B. Related Sections:

- 1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
- 2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.
- 3. Section 226600 "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

- 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- 2. Waste, Force-Main Piping: 50 psig (345 kPa).

- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. All Cast Iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF international.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. All Cast Iron Soil Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS, BELOW GROUND

- A. Pipe and Fittings: ASTM A 74, Extra Heavy class(es).
- B. Gaskets: Tyler "TY-Seal" ncoprene elastomeric compression type gaskets conforming to ASTM Standard C564
- C. Tensile Strength: 21,000 psi minimum in accordance with ASTM A74
- D. Piping shall be manufactured by a member of the Cast Iron Soil Pipe Institute (CISPI).
- E. Each length shall be marked with the size, Country of Origin, and manufacturer's name clearly cast or stamped on each length.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS, ABOVE GROUND

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Tensile Strength: 21,000 psi minimum.
- C. Piping shall be manufactured by a member of the Cast Iron Soil Pipe Institute (CISPI).
- D. Each length shall be marked with the size, Country of Origin, and manufacturer's name clearly cast or stamped on each length.
- E. CISPI, Hubless-Piping Couplings:
 - 1. Standards: ASTM C 1277 and CISPI 310.
 - 2. Description: Shield Assemblies shall consist of stainless steel bi-directional corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral center pipe stop. Couplings shall bear the NSF Trademark, and be manufactured in the USA.
 - 3. All Cast iron no-hub fittings shall be joined with "Heavy Duty" no-hub couplings constructed of a shielded coupling.
 - 4. Heavy duty no-hub couplings shall be Husky "Heavy Duty" SD4000 coupling.
 - 5. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ideal Tridon.
 - b. ANACO-Husky.
 - c. Mission Rubber Company.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Steel Pipe Pressure Fittings:
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 - 3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Shurjoint Piping Products.
 - c. Victaulic Company.
 - 2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
 - 3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.5 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Gaskets: AWWA C111/A21.11, rubber.

C. Ductile-Iron, Grooved-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
2. Ductile-Iron-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Victaulic Company.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
 - c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.6 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M (ASTM B 88M, Type B and Type C), water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
- E. Copper Pressure Fittings:
 - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B 32, lead-free with ASTM B 813, water-flushable flux.

2.7 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Non-pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Dallas Specialty & Mfg. Co.
 - 2) Dresser Couplings.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Non-pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) Ford Meter Box Company, Inc. (The).
 - 5) JCM Industries, Inc.
 - 6) Romac Industries, Inc.
 - 7) Smith, Jay R. Mfg. Co.
 - 8) Viking Johnson.

- b. Standard: AWWA C219.
- c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: [Manufacturer's standard] [Carbon steel] [Stainless steel] [Ductile iron] [Malleable iron].
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) A.Y. McDonald Mfg. Co.
 - 2) Capitol Manufacturing Company.
 - 3) Central Plastics Company.
 - 4) HART Industrial Unions, LLC.
 - 5) Jomar Valve.
 - 6) Watts; a Watts Water Technologies company.
 - 7) Wilkins.
 - 8) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Watts; a Watts Water Technologies company.
 - 4) Wilkins.

- 5) Zurn Industries, LLC.
- b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) Pipeline Seal and Insulator, Inc.
 - b. Description:
 - 1) Non-conducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig (1035 kPa).
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
5. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elster Perfection Corporation.
 - 2) Grinnell Mechanical Products.
 - 3) Precision Plumbing Products.
 - 4) Victaulic Company.
 - b. Description:
 - 1) Standard: IAPMO PS 66
 - 2) Electroplated steel nipple.

- 3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.8 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of virgin polyethylene material conforming to the requirements of ASTM D 1248, and a minimum thickness of 0.008-inch (0.20-mm) or, high-density, cross-laminated polyethylene film manufactured of virgin polyethylene material conforming to the requirements of ASTM D 1248, and of 0.004-inch (0.10-mm) minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.
- E. Install polyethylene encasement for Hubless, Service, and Extra Heavy DWV cast iron pipe and fitting systems in accordance with ASTM A 74, X3.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" and Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment".
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. All underground waste piping shall be hung by the slab on grade. Slab shall be imbedded with fishplate style inserts and all rods and hangers shall be stainless steel. All piping shall be supported by a minimum of 2 hangers per length of pipe.
- N. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 2. Horizontal Sanitary Drainage Piping: 1 percent downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- O. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- P. Install steel piping according to applicable plumbing code.
- Q. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.
- R. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- S. Install aboveground PVC piping according to ASTM D 2665.
- T. Install underground PVC piping shall not be installed.
- U. Install engineered soil and waste drainage and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- V. Install engineered [controlled-flow] [siphonic] drain specialties and storm drainage piping in locations indicated.
- W. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- X. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

- Y. Install force mains at elevations indicated.
- Z. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- AA. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- BB. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- CC. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- DD. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- EE. All horizontal piping 5" and larger branch openings, stack offsets and building drains serving 3 floors or more (Regardless of size) or changes in direction shall be suitably restrained to prevent movement of the joints, and possible separation. Restraint can be field fabricated, or pre-engineered and manufactured.
- FF. Drain pans and gutters for electrical equipment. This Contractor shall examine the drawings and in cooperation with the Electrical Trade confirm the final location of all electrical equipment to be installed in the vicinity of piping. Where feasible, piping shall not run over electrical equipment. Where not feasible to locate piping away from electrical equipment, plan and arrange all overhead piping no closer than four feet from a vertical line above electrical equipment, including but not limited to, elevator machine room equipment, main switchgear equipment, motor control centers, starter, electric motors, switchboards, panelboards, or similar equipment. Piping is not permitted in Electric Equipment, Transformer, Switch Gear, Elevator Equipment, and Telephone Gear Rooms.

1. Furnish gutters as follows:
 - a. Provide and erect a gutter of 16 ounce cold rolled copper or 18 gauge galvanized steel, under every pipe which is above any motor, electrical controllers, switchboards, panelboards, or the like.
2. Each gutter shall be reinforced, rimmed, soldered and made watertight, properly suspended and carefully pitched to a convenient point for draining. Provide a ¾" drain, with valve as directed, to nearest floor drain or slop sink, as approved.
3. In lieu of such separate gutters, a continuous protecting drain pan of similar construction adequately supported and braced, properly rimmed, pitched and drained to a floor drain or suitable waste, may be provided over any such electrical equipment, and extending 3' – 0" in all directions beyond the electrical equipment, over which such piping has to run.

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

- G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- I. Plastic, Non-pressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

- 1. Install transition couplings at joints of piping with small differences in OD's.
- 2. In Drainage Piping: Shielded, non-pressure transition couplings.
- 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
- 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
 - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

B. Dielectric Fittings:

- 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- 2. Dielectric Fittings for 3" and smaller: Use dielectric nipples.
- 3. Dielectric Fittings for NPS 4 (DN 125) and larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments and underground piping.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet (30 m) and less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet (30 m) if indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 - 6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- G. Install supports for vertical cast-iron soil piping every 12 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - 8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- I. Install supports for vertical steel piping every 15 feet (4.5 m).
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 4. NPS 3 and NPS 5 (DN 80 and DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- K. Install supports for vertical copper tubing every 5 feet.
- L. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- M. Install supports for vertical PVC piping every 36 inches.
- N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
- 3.7 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
 - C. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join similar piping materials.
 - D. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Install horizontal backwater valves with cleanout cover flush with floor. Comply with requirements for backwater valves, cleanouts and drains specified in section 221423 "Storm Drainage Piping Specialties."

E. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for [backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

F. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.
3. Storm Sewer: To exterior force main.
4. Sump Pumps: To sump pump discharge.

G. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

H. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap

- of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30kPa). From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.
- F. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed [ABS] [and] [PVC] Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE (SANITARY, WASTE AND VENT PIPING)

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings and solvent stack fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings and solvent stack fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- D. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- E. Aboveground, vent piping NPS 5 (DN 125) and larger shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

F. Underground, soil and waste piping shall be the following:

1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.

G. Aboveground sanitary-sewage force mains shall be the following:

1. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

H. Underground sanitary-sewage force mains shall be the following:

1. Ductile-iron, mechanical-joint piping and mechanical joints.
2. Ductile-iron, push-on-joint piping and push-on joints.
3. Ductile-iron, grooved-joint piping and grooved joints.

3.12 PIPING SCHEDULE - STORM PIPING

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and solvent stack fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

C. Underground storm drainage piping shall be the following:

1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.

D. Aboveground storm drainage force mains shall be the following:

1. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

- E. Underground storm drainage force mains shall be the following:
1. Ductile-iron, mechanical-joint piping and mechanical joints.
 2. Ductile-iron, push-on-joint piping and push-on joints.
 3. Ductile-iron, grooved-joint piping and grooved joints.

END OF SECTION

SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

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. Backwater valves.
- 2. Cleanouts.
- 3. Air-admittance valves.
- 4. Roof flashing assemblies.
- 5. Through-penetration firestop assemblies.
- 6. Miscellaneous sanitary drainage piping specialties.

B. Related requirements:

- 1. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
- 2. Section 076200 "Sheet Metal Flashing and Trim" for penetration of roofs.
- 3. Section 078413 "Penetration Firestopping for Firestopping Roof Penetrations".

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene.

1.4 ACTION SUBMITTALS

- A. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.
2. Wiring Diagrams: Power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.

2.2 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. WATTS.
 - f. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M.
 3. Size: Same as connected drainage piping
 4. Body Material: Hub-and-spigot, hubless, as required to match connected piping.
 5. Closure: Countersunk, cast-iron plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Stainless-Steel Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Josam Company.
2. Standard: ASME A112.3.1.
3. Size: Same as connected drainage piping
4. Body Material: Stainless-steel tee with side cleanout as required to match connected piping.
5. Closure: Stainless-steel plug with seal.

C. Stainless-Steel Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. Kusel Equipment Co.
 - c. Zurn Industries, LLC.
2. Standard: ASME A112.3.1.
3. Size: Same as connected branch.
4. Housing: Stainless steel.
5. Closure: Stainless steel with seal.
6. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.
7. Body or Ferrule: Stainless steel.
8. Clamping Device: Not required.
9. Outlet Connection: Threaded.
10. Closure: Cast-iron plug.
11. Adjustable Housing Material: Cast iron with threads.
12. Frame and Cover Material and Finish: Stainless steel.
13. Frame and Cover Shape: Round.
14. Top Loading Classification: Medium Duty.

D. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
 - e. WATTS.
 - f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M. Include wall access.
 3. Size: Same as connected drainage piping.
 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure Plug:
 - a. Cast iron.
 - b. Countersunk head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
 6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Thaler Metal Industries Ltd.
 - c. Zurn Industries, LLC.
2. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m, thick, lead flashing collar and skirt extending at least 10 inches (250 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.6 MOTORS

A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, motor shall be large enough, so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backwater valves in building drain piping.
 - 1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- G. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping."
- H. Assemble open drain fittings and install with top of hub 2 inches (51 mm) above floor.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

- J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- L. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- M. Install vent caps on each vent pipe passing through roof.
- N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- O. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- P. Install wood-blocking reinforcement for wall-mounting-type specialties.
- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections, and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled FOG disposal systems and their installation, including piping and electrical connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain FOG disposal systems. Refer to Section 017900 "Demonstration and Training."

END OF SECTION

SECTION 22 13 29.1

SUMP PUMPS

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.
- B. Mechanical systems commissioning Section 230800
- C. Plumbing systems commissioning Section 220800

1.2 SUMMARY

- A. This Section includes the following sewage and sump pumps and accessories for sanitary and sump drainage piping systems in buildings:
 - 1. Submersible sump pumps .
 - 2. Pump pits.

1.3 SUBMITTALS

- A. Product Data: For each type and size of pump specified. Include the following:
 - 1. System design information sheets indicating design parameters pump type, capacity and power requirements.
 - 2. Pump material and construction drawing.
 - 3. Pump curve indicating design point.
 - 4. Detailed sequence of operation.
 - 5. Electrical power and control wiring diagrams with indication of field wiring connections.
 - 6. Catalog information on major components.
 - 7. All of the above shall be specifically prepared and certified for this project.
- B. Submittals which are generic and not specifically designed to meet the requirements of this project shall not be acceptable.
- C. Operation and Maintenance Data: For each sewage pump to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Manufacturing firms regularly engaged in manufacture of this material meeting all capacities and operating characteristics of the specified manufacturer's product whose products have been in satisfactory use, in similar service, for not less than ten (10) years.
- B. Prior to shipment the pump manufacturer shall perform quality assurance tests to include: checks for compliance with specifications, operating the pumps submerged in water and verification of the integrity of the motor and cable insulation.
- C. The manufacturer of pumping equipment, or his representative, shall be responsible for the complete pumping system and its satisfactory performance as described in this section and shall provide a written guarantee covering all the equipment as well as the system performance for 12 months from date of start-up, not exceeding 18 months from date of shipment, additional extended Warranty shall apply if included below. The services of a factory trained engineer shall be provided for start-up and instruction of maintenance personnel.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

1.6 COORDINATION

- A. Coordinate size and location of concrete pits. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to full compliance with all specified requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

3. Alternate manufacturers of equipment will be considered only if the contractor submits detailed information and price reductions at the time of bid opening. These detailed proposals must include sufficient catalog information, including efficiencies, dimensions, and major component identification for proper evaluation of the alternate proposed. No alternate system by another manufacturer will be considered prior to considering alternate equipment of the specified manufacturer used as the basis of design.
4. Should the initial Alternate manufacturer's submittal be incomplete or otherwise fail to demonstrate full compliance with the specifications, no further submissions by the failed manufacturer will be reviewed.

2.2 SUBMERSIBLE SUMP PUMPS –

- A. Submersible: Factory-assembled and -tested, duplex, single-stage, centrifugal, end-suction, submersible, direct-connected Sump pumps complying with UL 778 and with HI 1.1-1.2 and HI 1.3 for submersible sump pumps. Pumps, motors, controls and basins shall be suitable for ambient temperatures.
 1. Manufacturers:
 - a. Stancor; Flow Solutions.
 - b. Grundfos
 - c. Or, Approved equal.
 2. Casing: AISI 304 Stainless Steel, all external bolts and nuts shall be stainless steel. Casing shall be designed with integral 2" NPT discharge connection. Pump shall include an integral inlet strainer.
 3. Impeller: Shall be AISI 304 Stainless Steel.
 4. Mechanical seals: Shall consist of two (2) separate seal assemblies operating in a lubricant chamber. The tandem seals shall have two separate silicon-carbide lapped face rings, no common parts shall be shared between the seals. The lower compression spring shall be protected against exposure to the pumped liquid. The mechanical seals and pump shall be designed and produced by the same manufacturer.
 5. Pump and Motor Shaft: Stainless steel ASTM A479 S43100-T with permanently grease lubricated bearings. The upper bearing shall be a C3 shielded ball bearing. The lower bearing shall be a C3 shielded ball bearing to compensate for axial thrust and radial forces. Pump and motor shaft shall be the same continuous unit, with no coupling required.
 6. Motor: The motor shall have a dry air-filled shell, designed for 180°C maximum and voltage tolerance shall be +10% and -14%. Each motor shall be capable of 10 equal starts per hour and shall be non-overloading of the complete pump curve. Pump and motor shall be capable of running in a dry condition. Cable sealing shall be accomplished by means of an elastomer grommet compression fitting, facilitating field cable service without the need for Epoxies, silicones, or other secondary sealants. The motor and pump shall be designed and produced by the same manufacturer.

7. Pump Discharge Piping: Preassembled package, SubRig prefabricated submersible pump assembly package to facilitate installation. The SubRig shall consist of cast iron full port self-cleaning ball check valves; full port fused Teflon ball isolation valves; color coded, grooved, interconnecting galvanized steel discharge fittings terminating in a true Y connection. The installation shall also contain stainless steel lifting chain. PP-5 duplex sub-rig to discharge through pit cover. PP-6 duplex sub rig assembly to be located in closet allocated for pump control panel and sub rig – discharge piping from each pump to run underground to subrig in closet.
- B. Pit Cover: Polished aluminum diamond plate, odor tight, gasketed with aluminum frame and cover suitable for pedestrian loading. Frame and cover shall be two-piece removable construction to facilitate installation and future replacement. Piping penetrations shall be by means of factory installed, heavy rubber, environ seals for PP-5, solid cover for PP-6 Cover hinges and all fasteners shall be stainless steel. The frame shall be set into the concrete floor mounted above the pumps. Contractor shall construct the perimeter edges of the pit with 3/4" x 3-1/2" step to insure flush installation of the cover.
- C. Controller: NEMA 250, Type 4X enclosure for 3 phase, 60 Hertz, 3 wire power supply, including
1. Circuit Breaker pump disconnects interlocked with compartment door.

Three pole across-the-line motor starters with three phase thermal overload protection and external reset buttons. 115-volt control power circuit transformer fused on both the primary and secondary sides.
 2. H-O-A selector switches.
 3. Audible alarm, silencing push-button and remote trouble alarm contacts.
 4. Set of necessary control relays and other accessory devices required to permit the system to operate in conformance with the specifications.
 5. All components shall be mounted on back panels.
 6. All internal wiring shall be numbered corresponding to the wiring diagrams.
 7. All connections to auxiliary contacts and control components, whether remote or panel mounted, shall be made to terminal strips.
 8. The control panel shall bear the UL508 label of Underwriters Laboratories signifying that all work performed by the manufacturer is in compliance with the requirements of the Underwriters Laboratories. Approval of just the enclosure or electrical devices is unacceptable.
 9. The controller shall be configured to accept one main power feed arrangement.
 10. The controller shall include auxiliary contacts (Form "C" (1-NO, 1-NC)) for interface with building automation system, for the following:
 - a. Control power available.

- b. Common system trouble alarm status.
- 11. Control panels which rely upon an electronic programmable controller (P.C.) for pump sequencing shall have redundant electromechanical devices which function to maintain pump operation in the event of a P.C. failure.
- D. Sequence of operation shall be as follows: Upon increasing liquid level the lead pump sensor shall activate, lead pump shall start and pump down to the pump off level set point. If the level continues to rise to the lag pump level set point, lag pump shall start and pump together with the lead pump down to the pump off level set point.
 - 1. The high-water level alarm set point shall activate the alarm system should the level continue to rise.
 - 2. pump will be activated by a 7-day exercise timer as adjusted in the field at time of start-up.
- E. The Pump Manufacturer's Representative shall have single source responsibility for the pumps and complete control system.
- F. In addition to the requirements of 1.4 Quality Assurance, the pump manufacturer shall warrant the pumps being supplied for a period of eighteen (18) months from date of shipment under normal operation and service. The warranty shall include parts and labor.
- G. Service Contract: The manufacturer's representative shall include a one (1) year service contract. The service contract period shall commence upon owner acceptance of the equipment. The service contract shall include a complete system inspection twice a year including check running amperage and voltage of all phases, check electrical resistance of motor windings, check condition of submersible cables, check for proper pump sequencing and alarm activation with adjustments, as required; and review of instructions for operating personnel, if requested. The contract shall also include an annual change of the seal chamber oil. Any required service work to be noted in a formal inspection report along with a detailed proposal for the repairs.

2.3 BUILDING AUTOMATION SYSTEM INTERFACE

- A. Provide auxiliary contacts (Form "C" (1-NO, 1-NC)) for interface to building automation system. Include the following:
 - 1. Control power available.
 - 2. Common system trouble alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

3.2 INSTALLATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."
- B. Set submersible sump pumps on pit floors. Extend piping discharge to indirect connections to storm drainage piping.
 - 1. Anchor guide-rail supports to pit bottoms and covers. Install pumps so pump and discharge pipe disconnecting flanges make positive seals when pumps are lowered into place.
- C. Construct pump pits and connect to drainage piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 22 Section "Storm Piping Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect sanitary drainage and vent piping to pumps. Install discharge piping equal to or greater than size of pump discharge piping. Install vent piping equal to or greater than size of pump basin vent connection. Refer to Division 22 Section "Sanitary Drainage and Vent Piping."
 - 1. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for sanitary waste piping.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 STARTUP SERVICE

- A. Prior to startup the Contractor shall perform the following:
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Hang submersible pump power cables, level control cables and pump removal chains permanently so they do not become entangled in the pumps during operation
 - 3. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - 4. Clean pit of all construction debris.

5. Verify that pump controls are correct for required application.
- B. Engage a factory-authorized service representative to perform startup service.
1. Verify that pump controls are correct for required application.
 2. Perform motor megger test in accordance with manufacturer's instructions.
 3. Start motors.
 4. Open discharge valves slowly.
 5. Check general mechanical operation of pumps and motors.
 6. Set pump controls for automatic start, stop, and alarm operation as required for system application.
 7. Verify that pump system operates in accordance with the specification, adjust settings as required. Test and adjust controls and safeties.
 8. Remove and replace damaged and malfunctioning components.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 221329.1

SECTION 224700

DRINKING FOUNTAINS AND WATER COOLERS

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. This Section includes the following drinking fountains and water coolers and related components:
 - 1. Drinking fountains.
 - 2. Pressure water coolers.
 - 3. Water-station water coolers.
 - 4. Remote water coolers.
 - 5. Fixture supports.

1.3 DEFINITIONS

- A. Accessible: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast-filled-polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain or water cooler unless one is specifically indicated.
- F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.
- G. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" Public Law 90-480, "Architectural Barriers Act" and Public Law 101-336, "Americans with Disabilities Act" for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filter Cartridges: Equal to 1 additional for each unit.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS AND/OR WATER COOLERS

- A. Refer to drawing schedule on drawings.

2.2 FIXTURE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- C. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Type I: Hanger-type carrier with two vertical uprights.
 - 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Set freestanding and pedestal drinking fountains on floor.
- D. Set remote water coolers on floor, unless otherwise indicated.
- E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Set pedestal drinking fountains on floor.
- C. Install recessed drinking fountains secured to wood blocking in wall construction.
- D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping".
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheon at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- H. Seal joints between fixtures and walls using sanitary-type, one part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants".

3.4 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.5 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.6 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.7 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

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SPECIFICATIONS GROUP

Facility Services Subgroup

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

Division	Section Title
230500	BASIC MECHANICAL REQUIREMENTS
230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230513.1	VARIABLE-FREQUENCY MOTOR CONTROLLERS
230517	SLEEVES AND SLEEVE SEALS FOR MECHANICAL PIPING
230518	ESCUTCHEONS FOR HVAC PIPING
230519	METERS AND GAGES FOR HVAC PIPING
230523	GENERAL-DUTY VALVES FOR HVAC PIPING
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230548	VIBRATION ISOLATION, WIND & FLOOD LOAD RESTRAINTS FOR HVAC, PLUMBING & ELECTRICAL COMPONENTS
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230700	HVAC INSULATION
230800	MECHANICAL COMMISSIONING
230900	CONTROLS FOR HVAC SYSTEMS
230993	SEQUENCE OF OPERATIONS
232113	HYDRONIC PIPING
232123	HYDRONIC PUMPS
232300	REFRIGERANT PIPING
232500	HVAC WATER TREATMENT
233113	DUCTWORK
233300	AIR DUCT ACCESSORIES
233416	HVAC FANS
233713	DIFFUSERS, REGISTERS, AND GRILLES
234100	PARTICULATE AIR FILTRATION
237313	MODULAR INDOOR CENTRAL STATION AIR-HANDLING UNITS
238126.1	MULTIPLE EVAPORATOR DIRECT EXPANSION VARIABLE CAPACITY SPLIT SYSTEMS
238219	FAN COIL UNITS, CABINET HEATERS, AND UNIT HEATERS
238233	RADIATORS AND CONVECTORS

END OF TABLE OF CONTENTS

SECTION 230500

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes general administrative and procedural requirements for mechanical installations.
- B. This Section is a part of each Division 23 Section.

1.2 DEFINITIONS AND INTERPRETATIONS

- A. A. Definitions:
 - 1. This section assumes that a Construction Manager is reporting directly to the Owner and is authorized to act on behalf of the Owner as called out. In any situation where a CM is not a part of the project, all responsibilities called to be by the CM will be performed by the General Contractor reporting directly to the Owner.
 - a. For purposes of these Specifications the following definitions apply:
 - b. "Engineer" - the Engineer of record.
 - c. "Provide" - to "furnish" and "install."
 - d. "Install" - to receive; handle; rig; set in place; join; unite; fasten; link; attach; set up or otherwise connect together; complete, tested and ready for normal satisfactory operation including all labor inclusive of start-up and commissioning.
 - e. "Furnish" - to supply all materials, equipment, testing apparatus, controls, tests, commissioning, accessories, warranty and all other items customarily required for the proper and complete application.
 - f. "As directed" - as directed by the Architect or the Engineer.
 - g. "Concealed" - embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings (including accessible ceilings).
 - h. "Exposed" - not concealed (visible without removal of wall or ceiling)
 - i. "Submit" - submit to the Architect and/or the Engineer for review.
 - j. "By Other Trades" or "Others" or "Oth"-----By persons or parties responsible for work at the project other than the party or parties who have been duly awarded the contract for the work of this trade. In the event that this document is used to acquire work as part of a general construction contract the words "by other trades"

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shall mean by persons or parties who are not anticipated to be the sub-contractor for this trade working together with the general contractor. In this context the words "by other trades" shall not be interpreted to mean not included in the overall contract.

- k. Where reference is made to "N.E.M.A. Standards," it shall be understood that this reference is to the "Approved Standards," published by the National Electrical Manufacturers Association, Main Office-155 East 44th Street, New York, NY 10017.
- l. Where reference is made to "A.N.S.I. Standards", it shall be understood that this reference is to the standards published by the American National Standards Institute Incorporated.
- m. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- n. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.
- o. No exclusions from, or limitations, in the language used in the drawings or specifications shall be interpreted as meaning that the appurtenances or accessories necessary to complete any required system or item of equipment are to be omitted.
- p. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Work shown on all drawings including floor plans, riser diagrams, schedules and details is the responsibility of the contractor regardless of conflicts and coordination. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance mechanical drawings, and in conformity with the dimensions indicated on final Architectural and structural working drawings and on equipment shop drawings.
- q. No interpretations shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- r. Certain details appear on the drawings, which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
- s. Information as to the general construction shall be derived from structural and Architectural drawings and specifications only.
- t. The use of words in the singular shall not be considered as limiting where other indications denote that more than one items is referred to.

B. Abbreviations:

1. For purposes of these Specifications the following abbreviations apply:
- 2.

C.	ADA	American Disabilities Act
D.	AGA	American Gas Association
E.	ANSI	American National Standards Institute
F.	ARI	Air Conditioning and Refrigeration Institute
G.	ASA	Acoustical Society of America
H.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
I.	ASME	American Society of Mechanical Engineers
J.	ASTM	American Society for Testing and Materials
K.	BMS	Building Management System
L.	BOCA	Building Officials and Code Administrators
M.	CA	Commissioning Authority
N.	CM	Construction Manager
O.	CX	Commissioning
P.	EPA	Environmental Protection Agency
Q.	ETL	Electronic Testing Laboratory
R.	FM	Factory Mutual
S.	FS	Federal Specification (General Services Administration)
T.	IEEE	Institute of Electrical and Electronic Engineers
U.	IRI	Industrial Risk Insurers
V.	MCAA	Mechanical Contractors Association of America

W.	MSDS	Materials Safety Data Sheet
X.	MSS	Manufacturer's Standardization Society Standards
Y.	NEBB	National Environmental Balancing Bureau
Z.	NYCEC	National Electrical Code (NFPA 70)
AA.	NEMA	National Electrical Manufacturers Association
BB.	NFPA	National Fire Protection Association
CC.	NUSIG	National Uniform Seismic Installation Guidelines
DD.	OSHA	Occupational Safety Health Administration
EE.	TAB	Testing and Balancing
FF.	UL	Underwriter Laboratories
GG.	UPS	Uninterruptible Power System
HH.	USGBC	United States Green Building Council

1.3 RELATED DOCUMENTS

- A. Submittals
- B. Construction Waste Management
- C. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and other sections of Division 23.
- D. Vibration, seismic, wind & flood criteria for this vendor is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section in its entirety.
- E. VOC Limits for Adhesives, Sealants, Paints and Coatings Section 018101
- F. Construction and Demolition Waste Management Section 018102
- G. Construction Indoor Air Quality (IAQ) Management Section 018103

1.4 QUALITY CONTROL

- A. Comply with current governing codes, ordinances and regulations, as well as with requirements of EPA, U.L. and all other applicable codes.
- B. Comply with the requirements of agencies or authorities having jurisdiction over any part of the work and secure all necessary permits.
- C. Where codes or standards are listed herein, the applicable portions apply.
- D. Plans, specifications, codes and standards are minimum requirements. Where requirements differ, apply the more stringent.
- E. Should any change in plans or specifications be required to comply with governing regulations, notify the Architect/engineer at the time of submitting this bid.
- F. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workmanlike manner by competent workmen. Provide a competent, experienced full-time superintendent who is authorized to make decisions on behalf of the contractor.
- G. All equipment and material to be furnished and installed on this Project shall be UL, ETL or any other recognized agency listed, and be suitable for its intended use in this project in accordance with the requirements of the city, state or any other Authority having jurisdiction.

1.5 APPLICABLE PUBLICATIONS

- 1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
 - A. Air -conditioning and Refrigeration Institute (ARI).
 - B. American National Standard Institute (ANSI).
 - C. Air Moving and Conditioning Association (AMCA).
 - D. American Society of Mechanical Engineers (ASME).
 - E. American Society of Plumbing Engineers (ASPE).
 - F. American Society for Testing and Materials (ASTM).

- G. National Fire Protection Association (NFPA).
- H. National Electrical Manufacturers Association (NEMA).
- I. American Association of Balancing Contractors (AABC).
- J. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
- K. American Welding Society (AWS).
- L. Cooling Tower Institute (CTI).
- M. Environmental Protection Agency (EPA).
- N. National Environmental Balancing Bureau (NEBB).
- O. National Electrical Code (NEC).
- P. Occupational Safety and Health Administration (OSHA).
- Q. Underwriters Laboratories (UL).
- R. Electrical Testing Laboratories (ETL).
- S. BOCA National Building Code.
- T. Uniform Building Code.
- U. Manufacturers' Standardization Society Standards (MSS).
- V. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- W. Weehawken Building Code.

1.6 PROPOSALS AND ALTERNATES

- A. See the Contractor's and/or Owner's "Instructions to Bidders" for Allowances, Unit Prices and Alternates.
- B. Compliance Reviews: The contractor and equipment vendor shall provide a Compliance Review with the bid proposal of the applicable Drawings, Specifications and Addenda and for all equipment and alternates listed hereinafter for this Project. The Compliance Review will be

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paragraph-by-paragraph review of the Specifications with the following information, "C", "D", "E" or "N/A", marked for each Specification section paragraph in the margin of the Specification and any subsequent Addenda.

- 1.
2. "C": Comply with no exceptions.
3. "D": Comply with minor deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
4. "E": Exception. Equipment, product or material does not comply. For each and every exception, provide a numbered footnote with reasons for the exception for the Owner's consideration and possible alternatives.
5. "N/A": The specification paragraph does not apply to the proposed equipment, material or product.
6. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the equipment proposed for this project is in complete compliance with the Contract Documents. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradictions do not release the Contractor from being in complete compliance, unless the exception or deviation has been specifically noted (explicitly, not by implication) in the Compliance Review.

C. Equipment Alternatives:

- 1.
2. Request for Substitution - Contractor initiated change to specified equipment or system for which the Owner/Architect/Engineer reserve the right to reject without review. Requests for Substitution must comply with the following:
3.
 - a. Submit proposals to supply substitute materials or equipment, in writing, to the Construction Manager. Include the following information with the proposal:
 - 1) A description of the difference between the contract document requirements and that proposed listing the comparative features of each, including operating cost impact and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of implementation costs.
 - 2) A list of the contract requirements that must be revised if the substitution is accepted, including any suggested specification revisions. Include a description and estimate of costs the engineer of record may incur in implementing the proposed substitution.
 - 3) Include a description and estimate of costs the Owner may incur in implementing the change, such as test, evaluation, operating and support costs.
 - 4) A projection of any effects the proposed change would have on collateral costs to the Owner.

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- 5) A statement of any effect on the contract completion time or the delivery schedule.
 - 6) A statement indicating the reduction to the contract price if the Owner accepts the change. Be responsible for appropriate modifications to all trades.
- 4.
 5. Include all revisions required to adapt substitutions in such proposals, including revisions by other trades. Only substitutions that reflect equal quality with a lower contract price and/or decreased operating costs will be considered.
 - 6.
 7. Wherever operating results such as quantity delivered or pressure obtained are scheduled, or when the make and size of apparatus, for which such quantities are readily determinable, is specified, the substitution being proposed must conform substantially to the quantities specified or implied. The substitution must fit into available space conditions and must function properly in coordination with the rest of the system.

1.7 DRAWINGS

- A. The Drawings show the general layout of the various items of equipment. However, layout of equipment, accessories, specialties, etc., are diagrammatic unless specifically dimensioned and do not necessarily indicate every required fitting, support or similar items required for a complete installation. Consult the Architectural Drawings and details for exact locations of fixtures and equipment. Where same is not definitively located, obtain the information from the Architect before proceeding. Any reasonable changes in locations indicated shall be made by the Contractor without additional cost to the Owner, if such changes are ordered prior to performance of the affected Work.
- B. The Contractor shall follow the Drawings in laying out the Work and check Drawings of all trades to verify spaces in which Work will be installed. Maintain maximum headroom and where space conditions appear inadequate; the Architect shall be notified before proceeding with the installation.
- C. Equipment shown on the Drawings has been coordinated for structural penetrations, electrical connection, operating and service (maintenance) requirements and physical size with regard to the space where the equipment is shown. If they comply with the Specifications, these and the other specified manufacturers of this equipment will be acceptable contingent on the Contractor providing a complete installation and maintaining full responsibility to provide, at no additional cost, any modifications to the Architectural, Structural, Mechanical or Electrical Systems that are required to properly install, operate and service the equipment being used. These modifications shall not include additional area for equipment unless approved by the Architect.
 - 1.

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2. The Contractor shall note these changes on the equipment submittals and the Compliance Review and shall show all differences in equipment being supplied from that specified and shown on the Drawings. Failure of the Contractor to provide this information with the submittal will indicate the submitted equipment meets or exceeds the requirements of the equipment shown on the Drawings in performance and is physically no larger in housing size.
 - a.
 - b. Failure of the Contractor to comply with the above and any discrepancies found should result in the Contractor providing equipment equal to that specified at the Contractor's expense.

1.8 SUBMITTALS

- A. General: The following information is required for review by the Owner, Architect and Engineer and is to be provided as it applies to this contract. It does not address items that may be required by the Construction Manager such as daily reports, minutes to safety meetings, etc.:
 1. Requisition Breakdown (include material quantities relative to each area, i.e., length of pipe or pounds of sheet metal)
 2. Unit Prices (prior to contract award)
 3. Wage Rate Breakdowns (prior to contract award)
 4. Projection of manpower loading
 5. Statement of review and acceptance of project schedule and task durations
 6. Site Safety Plan
 7. Submittal log
 8. Submittal data as defined below
 9. Drawing plot plan
 10. Coordination drawing log
 11. Proposed sub-contractors list
 12. Equipment manufacturers and material suppliers list
 13. Requests for substitution
 14. Manufacturer's Compliance reviews
 15. Contractor Certification forms
 16. Manufacturer's Certification forms
 17. List of samples to be submitted
 18. List of all permits to be provided
 19. List of all engineers providing sign-offs, certifications, and Controlled Inspections
 20. Sleeve and Slab penetration drawings
 21. Details and locations of embeds
 22. Equipment pad location and sizing drawings
 23. Drawings showing point loading of equipment and hung supports in excess of 200 pounds

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24. Pipe and Conduit expansion drawings and calculations
25. Seismic support drawings (see below)
26. List of items proposed to be ship fabricated along with skid details (Provide spool details on request.)
27. Shop Standards
28. Material Standards
29. Welding procedures and list of certified personnel with record of certification of steam piping is the responsibility of this contractor. (Submit copies of all reports and approvals on completion.)
30. Coordination drawings
31. Testing procedures including deferred testing (seasonal or out of sequence based on maintaining job progress schedule)
32. Flushing connection and bypass arrangement drawings approved by BMS contractor and equipment manufacturer were flushing through valves, instrumentation, and equipment is proposed.
33. Final reports on all flushing and chemical treatment of systems approved by chemical treatment manufacturer prior to start-up
34. Alignment reports
35. Manufacturers factory test reports
36. Manufacturer's and contractor's start-up reports
37. All MSDS forms for materials brought on site
38. List of all fuse sizes prior to start-up
39. Letter verifying that systems are ready for TAB Contractor to commence work as outlined in Specification Section 230593, Testing, Balancing and Adjusting.
40. Spare parts lists
41. O&M manuals
42. Valve tags list and Charts
43. As-built drawings
44. As-built reflected ceiling and floor drawings showing access door locations indicating type and nature of concealed device
45. Manufacturer's standard warranty along with signed acknowledgement of modified terms per this contract
46. Contractor warranty
47. Training Outlines and Agenda
48. Commissioning pre-functional testing forms
49. Commissioning logs and test results
50. Certified Project Record Documents
51. Updated Equipments Schedule Sheets
52. Notice of completion
53. Where Applicable:
54. Submit the following according to the Conditions of the Contract and as specified in Division 1 Section "SUBMITTALS."

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- B. The Division 23 Contractor shall submit a complete typed list of all mechanical equipment manufacturers and material suppliers for the equipment and materials they intend to furnish and install on this project for review by the Owner/Architect/Engineer prior to the award of the contract.
- C. Each Contractor shall prepare an index of all Division 23 submittals for the Project. The index shall include a submittal identification number, a cross-reference to the Specification Section or Drawing number and an item description. The submittal identification number shall be prefixed by the applicable Specification Section. Each submittal shall bear the submittal identification number in addition to the other data specified. All consultants, the Owner and all Contractors will utilize the assigned submittal identification number. If an expedited submittal review process is implemented on this Project, the equipment manufacturers, material suppliers list and submittals index will have to be submitted early to meet the requirements of the expedited submittal review procedure.
- D. Upon receipt of the approved manufacturers and material suppliers list, the Contractor shall immediately obtain complete Shop Drawings, Product Data and Samples and equipment and material Specification Compliance Review documents from the manufacturers, suppliers, vendors and all Division 23 Contractors, for all materials and equipment as specified herein in various sections of the specifications and shall submit data and details of such materials and equipment for review by the Architect and Engineer. Prior to submission of the Shop Drawings, Product Data and Samples to the Architect and Engineer, the Contractor shall thoroughly review the Shop Drawings, Product Data and Samples and verify they are in compliance with the Contract Documents. The Contractor shall provide a compliance review provided with the Contractor's Compliance Review will be a paragraph-by-paragraph review of the specifications with the following information marked for each Specification section paragraph or in the margin of the original Specification and any subsequent Addenda.
- 1.
 2. "C": Comply with no exceptions.
 - 3.
 4. "D": Comply with minor deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 - 5.
 6. "E": Exception. Equipment, product or material does not comply. For each and every exception, provide a numbered footnote with reasons for each exception and suggest possible alternatives for the owner's consideration.
 - 7.
 8. "N/A": The specification paragraph does not apply to the proposed equipment, material or product.
 - 9.

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10. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Contractor is in complete compliance with the Contract Documents. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not.
- 11.
12. The Contractor shall check all materials and equipment upon their arrival on the Project Site and verify their condition and compliance with the Contract Documents. Any work, which proceeds prior to receiving "Approved", Shop Drawings shall be modified as required to comply with the Contract Documents and the "Approved" Shop Drawings. A minimum period of fifteen (15) Working days, exclusive of transmittal time, will be required in the Engineer's office each time a Shop Drawing, Product Data and/or Sample is submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling his work.
- 13.
14. The review of Shop Drawings, Product Data and Samples by the Architect and Engineer shall not relieve the Contractor of the responsibility for dimensions of errors that may be contained therein for deviations from requirements in the Contract Documents. It shall be clearly understood that the noting of some errors by the Engineer but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, Product Data and Samples, the Contract Documents shall govern the Work and are neither waived nor superseded in any way by the review of Shop Drawings, Product Data and Samples.
- 15.
16. The Contractor shall observe the following procedures when submitting Shop Drawings, Product Data and Samples:
17.
 - a. Shop Drawings - Each Shop Drawing shall indicate in the lower right hand corner and each Product Data brochure shall indicate on the front cover of the following: the submittal identification number; title of the sheet or brochure; name and location of the Project; names of the Architect, Engineer, Contractor, Subcontractor, manufacturer, supplier and vendor; the date of submittal and the date of each correction and revision. All pages and drawings in Product Data brochures shall be numbered consecutively from beginning to end. So far as is practical, each Shop Drawing, Product Data and/or Sample shall bear a cross reference note to the page number or numbers of the sheet of the Drawings and/or Specifications showing the Work. Unless the above information is included, the submittal will be returned for re-submittal. Re-submittals of Product Data or brochures shall be complete and shall include a cover letter summarizing the corrections made in response to the review comments and the submittal page numbers, which were revised.
- 18.

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- a. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections and schematics to clearly describe the work. Drawings shall be prepared by a drafter or CAD technician skilled in this type of work. All sheet metal, piping, fire protection and similar Shop Drawings shall be drawn to at least 1/8" = 1'-0" scale. The Contractor shall submit Shop Drawings as described below. Shop Drawings, which do not comply with these requirements, will be returned for re-submittal.
- 19.
 20. The submittal shall consist of one (1) direct reading, clearly legible, paper sepia of each Shop Drawing. The Architect and Engineer will each review the paper sepia Shop Drawings. After review of the Shop Drawings, blueline prints will be produced from the registered paper sepia. The Shop Drawing(s) as marked by the Engineer, shall require the following action:
 21. 1) "APPROVED" means that fabrication; manufacture, installation or construction may proceed in compliance with the Submittal and the Construction Documents
 22. 1) Six (6) blueline prints from the reviewed registered sepia will be returned to the Contractor.
 - 2)
 - 3) The paper sepia will not be returned
 - 4)
 - 5) No additional submittal is required for the "APPROVED" Shop Drawings.
 23. a. "APPROVED AS NOTED" means that fabrication, manufacture, installation or construction may proceed in compliance with the Submittal, as annotated by the Engineer, and the Construction Documents, and, if noted, the contractor shall revise and resubmit the Submittal to incorporate the Engineer's annotated comments. If, for any reason, the Contractor shall make revisions to the Submittal in comments, the Contractor shall make revisions to the Submittal in order to incorporate those comments with which it can comply and resubmit the revised Submittal with a statement setting forth the comments with which it cannot comply and the reasons therefore.
 24. 1) The Owner, Architect and Engineer will each retain one (1) blueline print.
 - 2)
 - 3) Six (6) blueline prints from the reviewed registered sepia will be returned to the Contractor.
 - 4)
 - 5) The paper sepia will not be returned.
 - 6)

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- 7) The Contractor shall forward a written response to the items noted within fourteen (14) days of the Engineer's review date stamped on the Shop Drawing. The response must be certified as specified. Upon receipt of a satisfactory response, the status of the submittal will be revised to "APPROVED" by a written document to the Contractor prepared by the Engineer. If the response is not received by the Engineer in (14) days of the Engineer's review date stamped on the submittal, the "APPROVED" status will be rescinded by a written document to the Contractor prepared by the Engineer.
- 25.
26. "REVISE AND RESUBMIT" means that a portion of the Submittal does not comply with the design intent of the Construction Documents. Other portions of the Submittal, as noted, may proceed with fabrication, manufacture, installation or construction in compliance with the Submittal, as annotated by the Engineer, and the Construction Documents. The Contractor shall revise or replace the disapproved portions of the Submittal as noted and resubmit the entire revised or replaced Submittal.
- 27.
- a. The Owner, Architect and Engineer will each retain one (1) blue line print.
 - b.
 - c. The reviewed registered paper sepia will be returned to the Contractor.
 - d.
 - e. The submittal shall be corrected in accordance with Contract Documents and resubmitted in whole.
- 28.
- a. If the submittal is returned to the Contractor marked "DISAPPROVED," only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
- 29.
30. "DISAPPROVED" means that the Submittal does not comply with the design intent of the Construction Documents. Submittals stamped "Disapproved" are not to be used. The Contractor shall revise and resubmit the Submittal.
- 31.
- a. The Owner, Architect and Engineer will each retain one (1) blue line print.
 - b.
 - c. The reviewed registered paper sepia will be returned to the Contractor.
 - d.
 - e. The submittal shall be corrected in accordance with Contract Documents and resubmitted in whole for review. Note: The returned paper sepia stamped "DISAPPROVED" may not be resubmitted.
- 32.

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- a. If the submittal is returned to the Contractor marked "DISAPPROVED", only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
33. a. Subsequent submittals of any Shop Drawing previously marked "NOT APPROVED, REVISE AND RESUBMIT" shall have all corrections or other revisions clearly identified.
34. a. If the copy stamped "APPROVED" is altered for any reason after it has been stamped, the "APPROVED" shall automatically be voided.
35. a. All work shall be done in accordance with Shop Drawings stamped "APPROVED" insofar as these are in agreement with the Contract Documents. The "APPROVED" Shop Drawings shall be used in conjunction with the preparation of the Coordination Drawings specified hereinafter. Wherever differences occur between the Shop Drawings and the Contract Documents, the Contract Documents shall govern the work.
- 36.
37. Product Data - Product Data Submittals to be submitted shall be published by the manufacturers and shall contain complete and detailed engineering and dimensional information. The Contractor shall submit Product Data as described below. Product Data, which does not comply with these requirements, will be returned for re-submittal.
- 38.
39. Product Data submittals shall contain only information relevant to the particular equipment or materials to be furnished. The Contractor shall not submit catalogs, which describe several different items in addition to those items to be furnished and installed on this project, unless all irrelevant information is marked out or relevant information is clearly marked. Where applicable, equipment Product Data shall include wiring and interlock diagrams using the standard wiring diagrams with all terminal which have been provided for use by the Division 16 and/or BMS Contractors clearly indicated. All microprocessor-based equipment shall have Open Protocol and all information relative to the interface requirements and set-up shall be provided. Refer to the Electrical Drawings for additional information.
- 40.
41. The submittal shall consist of Product Data from each manufacturer. Contractor shall provide ten (10) copies for review unless instructed otherwise by the CM. The Shop Drawing(s) as marked by the Engineer, shall require the following action:
42. a. "APPROVED" means that fabrication, manufacture, installation or Construction may proceed in compliance with the Submittal and the Construction Documents.

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- 43.
- 1) The Owner, Architect, Engineer, and CA will each retain one (1) copy. The CM will retain four (4) copies for their records and coordination with other consultants and trades.
 - 2)
 - 3) Two (2) copies from the reviewed submittal will be returned to the Contractor.
- 44.
- 1) The Contractor shall resubmit the entire submittal for record purposes.
 - 2)
 - 3) The revised submittal shall be reviewed and confirmed to be compliant by the Engineer. The submittal, if fully compliant, shall be returned marked "APPROVED".
 - 4)
 - 5) If the submittal is returned to the Contractor marked "APPROVED AS NOTED", only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
- 45.
- a. "REVISE AND RESUBMIT" means that a portion of the Submittal does not comply with the design intent of the Construction Documents. Other portions of the Submittal, as noted, may proceed with fabrication, manufacture, installation or construction in compliance with the Submittal, as annotated by the Engineer, and the Construction Documents. The Contractor shall revise or replace the disapproved portions of the Submittal as noted and resubmit the entire revised or replace Submittal.
- 46.
- 1) The Owner, Architect, Engineer, and CA will each retain one (1) copy. The CM will retain four (4) copies for their records and coordination with other consultants and trades.
 - 2)
 - 3) Two (2) copies from the reviewed submittal will be returned to the Contractor.
 - 4)
 - 5) The Contractor shall resubmit the entire submittal for review.
 - 6)
 - 7) The revised submittal shall be reviewed and confirmed to be compliant by the Engineer. The submittal shall be returned marked by the Engineer.
- 47.

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- 1) If the submittal is returned to the Contractor marked "REVISE AND RESUBMIT", only one (1) additional submittal will be permitted without the Contractor incurring changes for the additional re-submittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
- 48.
- a. "DISAPPROVED" means that the submittal does not comply with the design intent of the Construction Documents. Submittals stamped "Disapproved" are not to be used. The Contractor shall revise and resubmit the Submittal.
- 49.
- 1) The Owner, Architect and Engineer will each retain one (1) blueline print.
 - 2)
 - 3) The reviewed registered paper sepia will be returned to the Contractor.
 - 4)
 - 5) The submittal shall be corrected in accordance with Contract Documents and resubmitted in whole for review. Note: The returned paper sepia stamped "DISAPPROVED" may not be resubmitted.
 - 6)
 - 7) If the submittal is returned to the Contractor marked "DISAPPROVED", only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
- 50.
- 1) Subsequent submittals of any Shop Drawings or Product Data Submittal requiring resubmission shall have all corrections or other revisions clearly identified.
- 51.
- 1) If the copy stamped "APPROVED" is altered for any reason after it has been stamped, the "APPROVED" shall automatically be voided.
 - 2)
 - 3) All work shall be done in accordance with Shop Drawings and/or Product Data stamped "APPROVED" insofar as these are in agreement with the Contract Documents. The "APPROVED" Shop Drawings shall be used in conjunction with the preparation of the Coordination Drawings specified hereinafter. Wherever differences occur between the Shop Drawings and the Contract Documents, the Contract Documents shall govern the work.
- 52.
- 1) Initial transmittal of manufacturer's data shall include two (2) copies of installation manuals and wiring diagrams.

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- 2)
 - 3) If not called for or defined in a particular specification section provide submittal data called for in "EQUIPMENT NOISE AND VIBRATION".
53. a. Prior to assembling or installing the work, the following shall be submitted by the contractor for review by the Engineer:
- 54.
- 1) Scale drawings indicating insert and sleeve locations.
 - 2)
 - 3) "Approved" Shop Standards and Material Submittal.
 - 4)
 - 5) Completed Coordination drawings signed by all trades and reviewed by the Engineer.
 - 6)
 - 7) "Approved" Submittals.
 - 8)
 - 9) Coordination drawings for access panel and door locations.
 - 10)
 - 11) Shop drawings detailing fabrication and installation for supports for mechanical materials and equipment.
 - 12)
 - 13) Welder Certificates signed by Contractor certifying that welders comply with requirements specified in Section 232113.23.
55. 1) Composite wiring diagrams.
56. a. Documents will not be accepted for review unless:
- 57.
- 1) They include complete information pertaining to appurtenances and accessories.
 - 2)
 - 3) They are submitted as a package where they pertain to related items.
 - 4)
 - 5) The submittal package is complete, containing all information required under the contract documents.
 - 6)
 - 7) They are properly marked with service or function, project name, where they consist of catalog sheets displaying other items, which are not applicable.
58. 1) They indicate the project name and address along with the Contractor's name, address and phone number.

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- 59.
- 1) They are properly marked with external connection identification as related to the project where they consist of standard factory assembly or field installation drawings.
 - 2)
 - 3) Equipment and materials requiring MEA approval shall be submitted with the MEA number and with a reprint of the MEA approval.
- 60.
- a. Shop Drawing Review
- 61.
- 1) The purpose of the review of shop drawings is to maintain integrity of the design. Unless the contractor clearly points out changes, substitutions, deletions or any other differences between the submission and the Contract Documents in writing on the Contractor's compliance review form, approval and/or review by the Engineer or Architect does not constitute acceptance. It is not to be assumed that the engineer has read the text nor reviewed the technical data of a manufactured item and its components except where the Vendor has pointed out differences on the Contractor's compliance review form between his product and the specified equipment, material or product. Any notations or markings on shop drawings made by the Architect/Engineer, which Contractor considers a change shall be immediately brought to the attention of the CM by submitting a formal Change Order Request. Procedure of fabrication of installation prior to such notification shall be at this Contractors risk.
- 62.
- 1) It is the responsibility of the contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by him with other trades during the preparation of the contractor's coordination drawings. Final Review of shop drawings containing errors does not relieve the contractor from making corrections at his expense.
- 63.
- 1) No shop drawings stamp or note shall constitute an order to fabricate or ship.
 - 2)
 - 3) The Contractor is responsible for seeing that "Approved" copies of shop drawings bearing the approval of the Architect/Engineer or Owner's Consultant are kept on the job site and work is implemented in the field in accordance with these documents.
- 64.
- 1) Where information from one Contractor is required by another contractor, it is the responsibility of the contractors to exchange information and coordinate their work.

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1.9 COORDINATION DRAWINGS

- A. The Contractor and all Subcontractors shall prepare a complete set of construction coordination drawings ("Coordination Drawings") indicating the equipment actually purchased and the exact routing and elevations for all lines such as piping, busway, conduit, ductwork, etc., including conduit embedded in concrete and openings, sleeves, etc., required in the structure, walls, partitions, etc.
- B. The Coordination Drawings shall be submitted complete for demonstration of compliance to the Architect, Engineer and Owner. All structural elements, footings, slab elevations and thickness shall be indicated.
- C. The sheet metal drawings prepared on electronic media (CAD) at a scale not less than $3/8" = 1'-0"$, shall serve as the base Drawings to which all other Contractors will overlay and add their Work. Each trade shall draw their Work on separate layers represented by individual colors. Each Coordination Drawing shall be completed and signed off by the other Contractors and the Contractor prior to the installation of the Work in the area covered by the specific Coordination Drawing.
- D. Any Work installed before coordinating with the Work of the other trades, shall be subject to removal and re-installation as required to correct the condition without extra cost to Owner.
- E. The Coordination Drawings shall indicate piping, conduit, busway and equipment support points and loads exceeding 500 lb. imposed on the building structure. Drawings shall be submitted to the Architect and Engineer of record for review. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points and the size of all lines shall be indicated. All beam penetrations, slab penetrations and sleeves shall be indicated, sized and coordinated with all other Work. All required code clearance space and required maintenance access space shall be indicated and coordinated with all other work. All Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated.

1.10 RECORD DOCUMENTS

- A. The Contractor shall maintain on a daily basis at the Project Site a complete set of Project Record Documents. The Project Record Documents shall consist of continuously updated AutoCAD files of the Coordination Drawings for this Division. The AutoCAD files shall be electronically updated by the Contractor's technician during the construction period to show the precise location of all buried or concealed work and equipment, including embedded piping and valves, field modifications and all changes and deviations in the Mechanical work from that shown on the Contract Documents.

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- B. The Contractor shall maintain on site a record of testing records, and pre-functional and functional testing forms and records.
- C. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without written definite instructions from the Architect or Engineer. Prior to commencing work, the Contractor shall obtain from the Architect or Engineer a set of AutoCAD format Drawings on compact disks, to be used only to produce the Coordination Drawings. The continuously updated Coordination Drawings shall be used to produce the final Project Record Documents, which shall be delivered to the Owner in latest version AutoCAD format CD-RW Recordable Rewrite Compact Discs upon Final Completion of the Project. The Contractor shall give to the Architect and Engineer a written release acceptable to the Architect and Engineer signed by a corporate officer of the Contractor prior to receipt of the Architect's and Engineer's compact disks.
- D. Record dimensions shall clearly and accurately delineate the work as installed; locations shall be suitable identified by at least two (2) dimensions to permanent structures.
- E. Prior to final acceptance of the work of this Division, the Contractor shall submit properly certified Project Record Documents to the Architect and Engineer for review and shall make changes, corrections or additions as the Architect and/or Engineer may require to the Project Record Documents. After the Architect's and Engineer's review and any required Contractor revisions, the Project Record Documents shall be delivered to the Owner on CD-RW Recordable Rewrite Compact Discs in latest AutoCAD format.
- F. Prepare project record documents in accordance with the requirements in Division 1 and as specified herein. In addition comply with the following.
 - 1.
 - 2. A complete set of "as-built" or record drawings shall be made up and delivered to the Architect.
 - 3.
 - 4. The drawings shall show:
 - a.
 - b. Piping systems, with valves and control devices located and numbered as shown on plans and BMS drawings, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 230553 Section "Mechanical Identification." Indicate horizontal locations of underground piping.
 - 5.
 - a. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - b.

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- c. Actual equipment and materials installed.
- 6.
 - a. This trade shall submit the as-built project record documents set for approval by the building department in a form acceptable to the department, when required by the jurisdiction.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall provide operating instructions and maintenance data books for all equipment and materials furnished under this Division as well as assist the CA in compiling and consolidating O&M information during the development of the site specific Commissioning Plan.
- B. Deliver two (2) initial copies of the operation and maintenance manuals to the Owner and Engineer for review with the equipment submittals. The initial copies shall contain all the information available at the time of submission.
- C. Submit six (6) final copies of operation and maintenance manuals to the Owner and Engineer for review at least two (2) months prior to training along with the training outlined. Assemble all data in a completely indexed volume or volumes in three ring binders and identify the size, model and features indicated for each item. The binders shall have the Project Name and Logo printed on the outside of the binders. Re-submittals of these final size (6) copies of the "Approved" operation and maintenance books and two (2) electronic CD-RW recordable rewrite compact disc shall be delivered to the Owner upon Final Completion of the Project.
 - 1.
 - 2. Vendor / Manufacturer shall supply complete operations and maintenance manuals in accordance with the following requirements:
 - 3.
 - 4. The operations and maintenance manual documentations shall be presented in an Avery 3" heavy duty white binder or equivalent at the time of original submission, and record manuals within four weeks of integrated delivery of equipment to the site.
 - 5.
 - 6. The binder shall have a cover page depicting the system(s) covered by the manual, the Owner name, site location, and date.
 - 7.
 - 8. The binder shall contain a detailed table of contents page delineating all major sections of the manual. Each section of the manual shall have an Avery narrow tab type divider placed between sections (properly labeled) to ensure easy access. The major sections of the manual shall include:
- D. Include the following information where applicable:

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- 1.
 2. Manual index
 3. Specification Section reference number and index.
 4. Equipment and/or material model number and serial numbers.
 5. Identifying name, mark number, plan/drawings tagging, etc.
 6. Locations of major equipment (where several similar items are used, provide a list).
 7. Manufacturer's catalogue literature including model, type, style, complete standard factory operations manual, brand name data, etc.
 8. Installation manual
 9. Operations manual
 10. Maintenance manual with lubrication charts, and recommended periodic maintenance and schedules.
 11. Detailed sequences of operation for all operating modes.
 12. Supplier, dealer, distributor, vendor and service organizations including phone, fax and e-mail addresses and name of contact person.
 13. "Approved" or approved submittals.
 14. Dimensional drawings with equipment weights
 15. List of spare parts recommended for normal service requirements.
 16. Assembly and disassembly instructions with exploded view Drawings where available.
 17. Manufacturer's recommended operation and maintenance instructions with all non-applicable information deleted.
 18. Trouble shooting diagnostic instructions where available.
 19. Copy of all welding certifications.
 20. Copy of all warranties and guarantees.
 21. Copy of all factory and field test reports.
 22. Completed Functional Test sheets.
 23. Completed Pre-functional checklists.
 24. Copies of all "Data Register" Sheets (see Specifications 230593, Testing, Balancing and Adjusting, Part 1, General, Submittals, Item E.1. (d))
 - 25.
- E. Items required for inclusion in the operations and maintenance manuals that cannot be provided at the time the O&Ms are initially submitted for review are expected to be submitted within ten (10) weeks of completion of the work in a format for insertion into the binder under a pre-fabricated tab that is identified in the table of contents (i.e., the site acceptance test may not be complete at the time this manual is required for submission, in this case the manufacturer shall submit the manual with this section empty, upon completion of the site acceptance testing the forms for this testing will be supplied (punched for the binder)).
- F. All documents shall be submitted electronically by computer disk in a dedicated sleeve within the binder.

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1.12 CODES, PERMITS AND INSPECTIONS

- A. All work shall meet or exceed the latest requirements of all national, state, county, municipal and other authorities exercising jurisdiction over construction work at the project. These include, but are not limited to the following:
 - 1. NFPA National Fire Codes
 - 2. New York State Department of Health
 - 3. New York State Building Code
- B. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the work.
- C. Any portion of the work, which is not subject to the approval of any authority having jurisdictions, shall be governed by the applicable sections of the overall National Fire Code, as published by the National Fire Protection Association.
- D. Installation procedures, methods, and conditions shall comply with the latest requirements of The Federal Occupational Safety and Health Act (OSHA).
- E. Provide and pay for the cost of the Controlled Inspections as called for in the Weehawken Building Code, Sections 27-132 and Section 27-136 and for filing all necessary building department reports for approval, Form TR-1, with the building department. Submit the name of the registered Professional Engineer who will be responsible for making the inspections for the Owner on Form TR-1 as soon as possible or within 90 days of the award of contract for approval by the Engineer of Record and Owner and file Form TR-1 with the building department.
- F. All equipment shall comply with "Materials & Equipment Acceptance Division" of N.Y.C. and Board of Standards and Appeals, and/or the Advisory Board of the Bureau of Gas and Electricity as applicable. Filing and approvals of such equipment shall be the responsibility of preparing and filing amendments with the Building Department. Application for Use Permits shall be filed by this trade.
- G. Prepare and submit to the building department a set of as-built project record documents record drawings for approval, in a form acceptable to the building department.
- H. This Contractor shall prepare all plans, amendments and pay all filing fees that will be required for the fuel burning installation, including boiler plant, gas/oil fired chillers, chimney, oil piping, fuel oil tanks, gas piping, breeching, and any or all parts of the system under the jurisdiction of the controlling agencies.

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- I. This Contractor shall prepare all plans, amendments and pay all filing fees that will be required for the emergency generator installation, including oil piping, engine exhaust, fuel oil tanks, and any or all parts of the system under the jurisdiction of the controlling agencies.
- J. This Contractor shall prepare all plans, amendments, and pay all filing fees that will be required for the electric generator and electric generator fuel oil tank installation.
- K. This Contractor shall be responsible for the installation and filing until the installation has been approved by the authorities having such jurisdiction.
- L. This Contractor shall prepare a plan of refrigeration room & file in accordance with Weehawken code, complying with all the requirements of the directive.
- M. All welding of high-pressure steam over 15 psig and High Temperature Hot Water Piping shall be under controlled inspection of an Engineer supervising a welding inspection agency acceptable to the Dept. of Bldgs. All costs associated with testing and inspection, including, x-rays, professional services and fees shall be paid by this contractor.
- N. Kitchen fire extinguishing system is to be filed by contractor where required by the controlling agency.

1.13 COORDINATION OF WORK BETWEEN TRADES

- A. The Heating, Ventilating and Air Conditioning Trade is required to supply all necessary supervision and coordination information to any other trades who are to supply work to accommodate the Heating, Ventilating and Air Conditioning installations.
- B. The heating, ventilating and air conditioning trade is required to supply all necessary supervision and coordination of all other trades required for the storage, transportation, installation, start-up, testing and commissioning of pre-purchased equipment.
- C. Where the Heating, Ventilating and Air Conditioning trade is required to install items, which it does not purchase, including pre-purchased equipment, it is required that this contractor assumes all responsibilities associated with the equipment as if they had purchased the equipment directly. This shall include but is not limited to the following:
 - 1.
 - 2. The coordination of their delivery, including prior notifications and overseeing the filing of all claims.
 - 3.

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4. Equipment is to be purchased inclusive of freight to an initial point of delivery. Contractor is to coordinate and assumes all costs for receipt at, storage at, and transportation to the site from a rigger's yard.
 - 5.
 6. Their unloading from delivery trucks driven in to any designated point on the property line at grade level.
 - 7.
 8. Their safe handling and field storage up to the time of permanent placement in the project.
 - 9.
 10. Their protection and periodic maintenance up to the time of Owner takeover o these responsibilities as defined by start-up, Owner acceptance, and warranty conditions defined herein.
 - 11.
 12. The correction of any damage, defacement or corrosion to which they may have been subjected.
 - 13.
 14. Their field assembly and internal connection as may be necessary for their proper operation.
 15. Their mounting in place including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to Architectural and structural conditions.
 - 16.
 17. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
 - 18.
 19. All labor including but not limited to installation, start-up, commissioning and warranty.
 - 20.
 21. Any and all documentation to be provided as required by the contract documents.
- D. Items which are to be installed but not purchased as part of the work of the Heating, Ventilating and Air Conditioning trade shall be carefully examined by this trade upon delivery to the project. Claims that any of these items have been received in such condition that deviates from information previously provided that their installation will require procedures beyond the reasonable scope of work of the Heating, Ventilating and Air Conditioning trade will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The work of the Heating, Ventilating and Air Conditioning trade shall include all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

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- E. Where multiple contracts are awarded involving the same trade for either base contract work or tenant fit-out, contractors shall coordinate their work and provide sufficient labor for the testing of the system as a whole.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Unit shall be stored and handled in accordance with manufacturer's instructions.
- C. Unit shall be shipped with all listed items and control wiring factory installed unless noted on the submittals and approved prior to shipment.
- D. Unit shall be shipped complete as specified. Parts for field installation shall not be shipped and stored on site without prior to shipment.
- E. Rigging: Units shall be fully assembled. Units requiring disassembly for rigging shall be factory assembled and tested. Disassembly, reassembly and testing shall be supervised by the manufacturer's representative.
- F. Unit shall be shipped with firmly attached labels that indicate name of manufacturer, model number, serial number, and plan tagging.
 - 1.
- G. The Vendor shall shrink-wrap all equipment and spare parts prior to shipping. Spare parts are to be delivered at time of owner acceptance.

1.15 PRECONSTRUCTION CONFERENCE PRIOR TO START OF WORK

- A. Prior to commencing any work, the CM, together with designated major Contractors, shall confer with the Architect and Engineer concerning the work under the Construction Contract.
- B. The pre-construction conference will be conducted under the leadership of the CM and will occur soon after the CM notifies the Subcontractors of contract award. The pre-construction conference will focus on items such as the expedited submittal review procedure, interface and coordination between Contractor work scope, the CM's project site rules and requirements, temporary utility requirements, CM's construction schedule, etc.

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- C. Prior to start of work and prior to preparation of any submittals there shall be an interface meeting between fire alarm contractor, HVAC contractor, controls contractor and VFD vendor to coordinate hardwired safeties, fire alarm, and BMS monitoring termination points.

1.16 GUARANTEES, CERTIFICATIONS AND WARRANTY PERIOD

- A. Contractors and their Manufacturers shall provide a 1-year full parts and labor warranty. Contractor must maintain a local full time service company with 24-hour emergency service capable of responding to service needs within 4-hours. Contractor shall be aware that during the full warranty period as defined above, Manufacturers of certain pre-purchased equipment as called for in purchase agreements by the CM are to provide all required periodic and routine service and maintenance. The Manufacturers through the Contractor shall submit a service and maintenance plan for approval by the Owner. The Manufacturer must comply with the requirements of Owner's Service Contract terms and conditions. When purchase agreements are made the responsibility of this Contractor, all service agreements called for in specification sections shall be made part of the initial purchase and shall pass directly to the Owner. All other equipment, systems and related appurtenances shall be the responsibility of the Contractor for warranty. All warranty claims whether for pre-purchased or direct purchased equipment shall be the responsibility of the Contractor.
- B. During the warranty period, the Contractor shall guarantee the following in a form satisfactory to the Owner:
 - 1.
 - 2. All work installed will be free from any and all defects in Workmanship and/or materials.
 - 3.
 - 4. All apparatus will develop capacities and performance characteristics specified.
 - 5.
 - 6. The systems shall operate without malfunction.
- C. The Contractor shall, without cost to the Owner, remedy any defects within a reasonable time to be specified in notice from the Architect. In default thereof, the Owner may have such Work done and charge all costs to the Contractor.
- D. The start of the Contractor's warranty period, as defined above, shall have no restrictions on start date and extend for the full period noted.
- E. The Contractor shall confer with the CM prior to the bid date concerning the Schedule and determine if there is a need to operate any items of equipment or systems for temporary heating and/or cooling or other reasons prior to substantial completion. All required extended warranty costs for equipment, materials and systems shall be included in the Contractor's proposal and clearly designated with a breakout price. All equipment or systems used for temporary heating

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and/or cooling shall be restored to "as new" condition by this Contractor and all associated costs shall be included in the Contractor's bid proposal.

1.17 FINAL REVIEW AND ACCEPTANCE

- A. At a time designated by the Owner and after Commissioning of the systems, the entire system will be reviewed for compliance with the Contract Drawings and Specifications. The Contractor shall be available at all times during this review.
- B. Prior to the Final Review field visit, the Contractor will submit to the Engineer a written certification that: 1) attests to the Contract Document compliance for this Project prior to the Engineers Final Review field visit, and 2) certifies that the equipment and materials installed in this project under this Division contain no asbestos or P.C.B.
- C. Operate the entire system properly with all systems balanced and all controls adjusted for a minimum period of ten (10) days.
- D. Certificates and Documents required herein to be in order and presented to the Engineer at least two (2) weeks prior to the Final Review.
- E. After the Final Review, any changes or corrections noted as necessary for the work to comply with the requirements of the contract documents are to be accomplished without delay in order to secure final acceptance of the work.

1.18 OPERATING INSTRUCTIONS AND TRAINING

1.

- A. This Contractor shall be responsible for the training of Owner personnel for both the equipment and systems this Contractor installs as well as responsible to participate in the training of all systems that interfere with the work of other Contractors and Vendors. The Contractor shall, in addition to start up services, provide factory trained specialists to supervise commissioning and instruct the Owner's operators during operating instruction periods.

2.

- B. Training shall consist of a minimum numbers of hours as listed below (minimum of 4 hours if not shown) of Owner instructions. Days shall not be defined as 8 hour periods, shall not be consecutive, and are separate and apart from start-up and commissioning. This shall consist of both classroom and in-the-field training. All training materials and a training curriculum unique to this project will be presented to the Owner 2 months in advance of the on-site training. Training will commence only after the approval of the curriculum and agenda by the Owner

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and the CA. The Owner may wish to videotape the on-site training. The Contractor and their vendors agree to allow videotaping of instruction periods. Include in addition to the periods of training listed:

3.
 1. Periods at night for training of night shift personnel.
 2. Periods for use of the equipment for temporary Heating and Cooling.
 3. Periods to be present during Owner instruction on the BMS.
 4. Periods of training on major vendor furnished components such as variable speed drives by the variable speed drive equipment manufacturer.
 - 5.
- C. The Contractor shall commence no instruction period until all requirements of this section are met and the Owner has issued his written acceptance of the Contractor's submitted agenda, starting time and Schedules.
- 4.
- D. The CM shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
- 5.
- E. The mechanical contractor shall provide the CA with a training plan at least two months before the planned training according to the following outline:
 6.
 1. Equipment (included in training)
 2. Intended audience
 3. Location of training
 4. Objectives
 5. Subjects covered (description, duration of discussion, special methods, etc.)
 6. Duration of training on each subject
 7. Instructor qualifications and experience for each subject
 8. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)

9. Instructor and qualifications
- 7.
- F. Training shall include:
 8.
 1. Use of the printed installations, operation and maintenance instruction material included in the O&M manuals.
 2. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 3. Include a review of all systems using the simplified system schematics, riser, and one-line drawings.
 4. Include a review of all as-built drawings.
 5. Basic engineering principals of operation for each piece of equipment.
 6. Performance of equipment under different environmental and operating conditions.
 7. Equipment submittal data and performance curves.
 8. Equipment construction.
 9. Equipment safeties and alarms.
 10. Equipment alarm and program settings.
 11. Operation limitations/restrictions.
 12. Operation modes/(response-action format)
 13. Failure modes/(response-action format)
 14. Maintenance modes/(response-action format)
 15. Control power and appurtenances.
 16. Include field walk-throughs to locate all concealed devices, review valve, duct and pipe tagging method, review equipment locations and tagging.

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17. Discussion of relevant health and safety issues and concerns.
 18. Discussion of warranties and service contracts.
 19. Common troubleshooting problems and solutions.
 20. Location of all plans and manuals in the facility.
- 9.
- G. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative.
- 10.
- H. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
- 11.
- I. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
- 12.
- J. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central building control system.
- 13.
- K. The mechanical contractor shall provide training on each piece of equipment according to the following schedule:

14. Hours	System
8	Hot & Condenser Water Pumping & Piping System
4	Chemical Treatment
4	Packaged Air Conditioning and Heat Pump Units
8	Variable Speed Drives

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8	Fans Systems
4	Fresh Air Intakes & Exhaust Systems
4	Fan Coil Units
4	Finned tube radiation, cabinet heaters, unit heaters
4	Elevator Machine Room Exhaust
4	Emergency Power & Cogen System
4	Service Hot Water Heaters
4	Sewage Ejectors
8	Electronic Faucets & Flush-o-meters
8	Fire Protection System
8	Fire Pumps & House Tanks
4	Kitchen Exhaust System
4	Domestic Water System
4	Leak Detection Systems
8	Testing & Balancing

15. L. BMS training is indicated in Section 230900.

1.19 TEMPORARY HVAC SYSTEM OPERATION

16.

17. A.All HVAC systems placed in operation for temporary heating and ventilation and/or cooling shall be operated in full accordance with manufacturer's recommendations for an occupied building. The specified permanent filters shall be in place and filters shall be changed on a regular basis upon reaching the specified final pressure drop. During temporary HVAC system operation, all return air grilles and duct openings shall be

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covered with fiberglass filter media. Visually inspect the filter media on a weekly basis and replace as necessary.

1.20 INDOOR AIR QUALITY MANAGEMENT PROCESS

18. A. This project shall undergo an Indoor Air Quality (IAQ) Management Process during construction. Refer to Division 1 for specific requirements. Cooperate fully with the IAQ Manager at all times.

1.21 ACCESS DOORS GENERAL CONSTRUCTION

19.
 - A. Access doors are required for operation and maintenance of concealed equipment, valves, controls, etc., will be provided by this subcontractor and installed under another section of the work.
20.
 - B. This trade is responsible for access door location, size and its accessibility to the valves or equipment being served.
21.
 - C. Coordinate and prepare a location, size and function schedule of access doors required, and deliver to a representative of the installing section.
22.
 - D. Access doors shall be of ample size, minimum of 16" x 16". Type as specified under another Section 083113.

1. END OF SECTION

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SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 REFERENCE STANDARDS

- A. Each motor, controller and all components shall be designed, manufactured and tested in accordance with the following latest applicable standards:
 - 1. National Electric Manufacturers Association Standards (NEMA)
 - 2. ANSI/NEMA MG 1-2006- Motors and Generators
 - 3. Weehawken Electrical Code
 - 4. IEEE-112, Test Method "B"
 - 5. IEEE Standard 519-1992
 - 6. NEMA- ICS-3-303
 - 7. IEE STD 444 (ANSI C34.3)
 - 8. Energy Policy Act of 1992 (EP Act)
 - 9. Energy Policy Act of 2007
 - 10. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.
- B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to Division 01 Section "General Requirements" and shall include, but not be limited to:
 - 1. Electric Motors - for all equipment not included under another Section. Shop Drawings shall state the motor manufacturer, frame size, horsepower, frequency, voltage, power factor, efficiency, speed starting torque class, insulation class, service factor and winding material. In addition, special shaft or mounting detail requirements as well as shaft limitation details and any other special requirements shall be listed on these Drawings.
 - 2. Motor Controllers - for all controllers not included under another Division.
 - 3. Variable Speed Drives - for all variable speed drives not included under other sections of Division 23 Specifications. Complete with enclosure construction details, line reactor or tuned filter data, design features, accessories, disconnect, capacitor, mechanical bypass, if specified, and spare parts data.
- C. All items or equipment listed above with asterisk (*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Division 01 Specification Sections.

1.5 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.
- B. Furnish and install all motors, variable speed drives and controllers that are not furnished as part of the Motor Control Centers but required for controlling the HVAC equipment and motors.
- C. Coordinate with Division 26000 work for proper integration of electrical power supply wiring with the motors, etc., provided under Division 23000.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.2 ACCEPTABLE MANUFACTURERS

- A. If it complies with these Specifications, motors manufactured by one of the following manufacturers will be acceptable:
 - 1. Baldor
 - 2. Century/MagneTEK
 - 3. General Electric
 - 4. Marathon
 - 5. Lincoln
 - 6. Reliance
 - 7. Siemens
 - 8. Toshiba
 - 9. U.S. Motors
 - 10. Westinghouse

2.3 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. In general, motor voltages shall be as follows, unless specified or indicated otherwise:
 - 1. $\frac{3}{4}$ hp and larger - 208V or 460V, three (3) phase, 60 hertz
 - 2. Smaller than $\frac{3}{4}$ hp - 120V, one (1) phase, 60 hertz
- D. All motors shall be started across the line, unless specified otherwise. All motors 100 horsepower and larger shall be suitable for wye-delta starting unless specified otherwise. Motors shall be selected with low starting current and shall be designed for continuous duty to provide the running torque and pull in torque required to suit the load. Unless otherwise indicated on the Contract Documents, all motors shall be single speed (1750 rpm). All motors shall have standard open drip proof enclosures unless otherwise specified. All motors exposed to the outdoor or actually installed outside in the weather shall be of the Totally Enclosed Fan Cooled (TEFC) or Totally Enclosed Air Over (TEAO) types. All motors not utilized with

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variable speed drives shall have a minimum service factor of 1.15 and shall be selected to operate at design conditions without exceeding their nameplate rating (without exploiting the service factor rating). Motors used in conjunctions with variable speed drives shall have a 1.00 service factor unless otherwise indicated and be compatible with the drive and rated for inverter output duty. Two (2) speed motors shall be two (2) speed, two (2) winding or two (2) speed, single winding type as specified herein and as indicated on the Contract Documents.

1. Standard open drip proof three (3) phase motors ten (10) horsepower and smaller shall have cast aluminum end bells with steel frames. Three (3) phase motors fifteen (15) horsepower and larger shall have cast iron end bells and housings.
2. Standard open drip proof single-phase motors shall have cast aluminum end bells with steel frames.
3. Totally Enclosed Fan Cooled (TEFC) and Totally Enclosed Air Over (TEAO) three (3) phase motors shall have cast iron housings. TEFC motors shall have corrosion resistant fans.
4. Vertical pump motors shall have cast iron end bells and cast aluminum housing. These motors shall be sized to drive the pump through its characteristic curve without exceeding the rated motor full load horsepower.

E. Windings and Insulation:

1. All motors shall have copper windings.
2. Motors shall be equipped with Class B, 80°C rise or Class F, 105°C rise insulation suitable for use in a 40°C ambient temperature. All motors used for cooling tower applications shall be equipped with Class F, 105°C rise insulation suitable for use in a 40°C ambient temperature. Windings shall be treated with an epoxy varnish to inhibit the absorption of moisture.

F. Bearings:

1. Single phase, fractional horsepower motors shall be equipped with quiet operating, all angle, Babbitt lined sleeve bearings.
2. Polyphase motors shall be equipped with deep groove type ball bearings, generously sized for the loads to which applied and for severe duty application. Provide the necessary seals on the shaft to keep the bearing system free of contamination and moisture. Lubricant shall be high temperature, non-bleeding grease.
3. Provide inlet and outlet plugs on poly-phase motors so that grease fittings can be easily inserted for bearing re-lubrication except as otherwise specified. The end shields shall be carefully machined to add extra grease capacity. Lower outlet plugs shall be equipped with combination breather/drains on TEFC and TENV motors.

- G. Motors shall be specifically designed for quiet operation and for severe duty. Standard open drip proof motors shall be equipped with aluminum or stainless steel stamped nameplates. Totally enclosed fan cooled and air over motors shall be equipped with stainless steel stamped nameplates with either zinc or cadmium plated hardware. Motor nameplates shall clearly

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indicate frame size, horsepower, frequency, voltage, speed, starting torque class, insulation class, service factor and winding material.

- H. High efficiency, three (3) phase, general purpose, continuous duty, T-frame, squirrel cage induction motors shall be specifically designed per IEEE-112, test method "B" procedures and shall have at least the following power factor and efficiency:

Size HorsePower	ODP Full Efficiency* 1800 RPM	Motors Load	TEFC Full Efficiency*	Motors Load
1	85.5		85.5	
1-1/2	86.5		86.5	
2	86.5		86.5	
3	89.5		89.5	
5	89.5		89.5	
7-1/2	91.0		91.7	
10	91.7		91.7	
15	93.0		92.4	
20	93.0		93.0	
25	93.6		93.6	
30	94.1		93.6	
40	94.1		94.1	
50	94.5		94.5	
60	95.0		95.0	
75	95.0		95.4	
100	95.4		95.4	
125	94.4		95.4	
150	95.8		95.8	

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200	95.8	96.2
250	95.8	96.2
300	95.8	96.2

1. * Minimum efficiencies as per NEMA MG-1 Table 12-GG for EPACT "92" "Energy Efficient" motors. These tables do not apply to Inverter Duty Rated motors, multi-speed motors; close coupled or definite/special purpose motors and U frame motors.

- I. Refer to various Sections of this Division for special requirements for specific items of equipment requiring motors and for any other special requirements such as variable speed, multiple windings/speeds, reduced voltage starting, etc. Motors used in conjunction with variable speed drives shall be compatible with the drive and rated for inverter output duty.
- J. Electric motors on fire pumps shall be standard efficiency.

2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Motor and controller installation shall be in accordance with the manufacturer's recommendations and as indicated on the Drawings. Align pulleys and install all belts at proper tension to minimize wear on belts and drives.

B. Variable speed drive installation shall be in accordance with the manufacturer's recommendations and as indicated on the Drawings. Input power, output power, and Division 15. Building Management System (BMS) control wiring shall be installed in separate conduits per manufacturer's recommendations.

3.2 FACTORY TESTING

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- A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.

3.3 FIELD TESTING

- A. Refer to Section 230513.1 & 230513.2 for additional testing requirements motors and controllers.

END OF SECTION

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SECTION 230513.1

VARIABLE-FREQUENCY MOTOR CONTROLLERS (VFD/VFC)

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.
- B. Vibration, seismic, wind & flood criteria for this vendor is referenced in specification Section 230548. Vendor/manufacturer/contractor is responsible for this section in its entirety.
- C. VOC Limits for Adhesives, Sealants, Paints and Coatings Section 018101
- D. Construction and Demolition Waste Management Section 018102
- E. Construction Indoor Air Quality (IAQ) Management Section 018103

1.2 SUMMARY

- A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.
- B. Related Sections:
 - 1. Division 26 Section "Motor-Control Centers" for VFCs installed in motor-control centers.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CE: Conformance Europeene (European Compliance).
- C. CPT: Control power transformer.
- D. EMI: Electromagnetic interference.
- E. IGBT: Insulated-gate bipolar transistor.

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- F. LAN: Local area network.
- G. LED: Light-emitting diode.
- H. MCP: Motor-circuit protector.
- I. NC: Normally closed.
- J. NO: Normally open.
- K. OCPD: Overcurrent protective device.
- L. PCC: Point of common coupling.
- M. PID: Control action, proportional plus integral plus derivative.
- N. PWM: Pulse-width modulated.
- O. RFI: Radio-frequency interference.
- P. TDD: Total demand (harmonic current) distortion.
- Q. THD(V): Total harmonic voltage demand.
- R. VFC: Variable-frequency motor controller.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

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- B. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
 - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Enclosure types and details.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of enclosed unit.
 - f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.
 - g. Specified modifications.
 - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.
- C. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible or if indicated designated operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels.
- D. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- E. Qualification Data: For qualified testing agency.
- F. Seismic Qualification Certificates: For VFCs, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.
- G. Product Certificates: For each VFC, from manufacturer.
- H. Source quality-control reports.

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- I. Field quality-control reports.
- J. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - 3. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - 4. Manufacturer's instructions for starting & description of unsafe operating conditions.
- K. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. IEEE Compliance: Fabricate and test VFC according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. All VFDs on project shall be of the same manufacturer and type.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site, under provisions of general conditions.
- B. Accept VFC on site in original packing. Inspect for damage.
- C. Store in a clean, dry space. Maintain factory wrapping, or provide an additional heavy canvas or heavy plastic cover, to protect units from dirt, water, construction debris, and traffic.

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- D. Handle carefully, in accordance with manufacturer's written instructions, to avoid damage to components, enclosure, and finish.
- E. If stored in space that is not permanently enclosed and air-conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller connect factory-installed space heaters to temporary electrical service.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 14 deg F and not exceeding 104 deg F.
 - 2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
 - 3. Humidity: Less than 95 percent (noncondensing).
 - 4. Altitude: Not exceeding 3300 feet.
 - 5. Comply with NFPA 70E.
- B. Product Selection for Restricted Space: Indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.9 COORDINATION

- A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
 - 1. Torque, speed, and horsepower requirements of the load.
 - 2. Ratings and characteristics of supply circuit and required control sequence.
 - 3. Ambient and environmental conditions of installation location.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.

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1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.
 - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.
 - 6. Control Board: One for each type.
 - 7. Drive Board: One for each type.

PART 2 - PRODUCTS

2.1 VFDs GENERAL

- A. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- B. Application: Constant torque and variable torque.
- C. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
 - 1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
 - 2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 - 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

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- E. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFC input voltage rating.
 2. Input AC Voltage Unbalance: Not exceeding 5 percent.
 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 4. Minimum Efficiency: 98 percent at 60 Hz, full load, 96 % percent at half load.
 5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
 6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
 7. Ambient Temperature Rating: Not less than 14 deg F and not exceeding 104 deg F.
 8. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
 9. Humidity Rating: Up to 95 percent (noncondensing).
 10. Altitude Rating: Not exceeding 3300 feet.
 11. Vibration Withstand: Comply with IEC 60068-2-6.
 12. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.7 times the base load current for one second.
 13. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 14. Speed Regulation: Plus or minus 5 percent.
 15. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
 16. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.
 2. Signal: Pneumatic.
- I. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 0.1 to 999.9 seconds.
 4. Deceleration: 0.1 to 999.9 seconds.
 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- J. Self-Protection and Reliability Features:

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1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 3. Under- and overvoltage trips.
 4. Inverter overcurrent trips.
 5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
 6. Critical frequency rejection, with three selectable, adjustable deadbands.
 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 8. Loss-of-phase protection.
 9. Reverse-phase protection.
 10. Short-circuit protection.
 11. Motor overtemperature fault.
- K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- P. Integral Input Disconnecting Means and OCPD: NEMA KS 1, Circuit Breaker with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
 2. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
 3. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
 4. NC, NO alarm contact that operates only when circuit breaker has tripped.

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- Q. Units to be provided in factory standard sizes and factory standard configurations unless otherwise noted. Custom built units/enclosures will not be accepted unless specifically requested.
- R. Controls and indication
1. Status Lights: Door-mounted LED indicators displaying the following conditions:
 - a. Power on.
 - b. Run.
 - c. Overvoltage.
 - d. Line fault.
 - e. Overcurrent.
 2. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 - a. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 - b. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - 1) Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
 3. Historical Logging Information and Displays:
 - a. Retain first subparagraph below if time and date stamping is not accomplished through the BAS. This is an added-cost option with some listed manufacturers.
 - b. Elapsed & Real-time clock.
 - c. Running log of total power versus time.
 - d. Total run time.
 - e. Fault log, maintaining last 10 faults with elapsed & real stamp for each.
 4. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
 - a. Output frequency (Hz).
 - b. Motor speed (rpm).
 - c. Motor status (running, stop, fault).
 - d. Motor current (amperes).
 - e. Motor torque (percent).

- f. Fault or alarming status (code).
 - g. PID feedback signal (percent).
 - h. DC-link voltage (V dc).
 - i. Set point frequency (Hz).
5. Control Signal Interfaces:
- a. Electric Input Signal Interface:
 - 1) A minimum of two programmable analog inputs: 0- to 10-V dc Operator-selectable "x"- to "y"-mA dc.
 - 2) A minimum of six multifunction programmable digital inputs.
 - b. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
 - 1) 0- to 10-V dc.
 - 2) 4- to 20-mA dc.
 - 3) Potentiometer using up/down digital inputs.
 - 4) Fixed frequencies using digital inputs.
 - c. Output Signal Interface: A minimum of two programmable analog output signal(s) (0- to 10-V dc 4- to 20-mA dc operator-selectable "x"- to "y"-mA dc), which can be configured for any of the following:
 - 1) Output frequency (Hz).
 - 2) Output current (load).
 - 3) DC-link voltage (V dc).
 - 4) Motor torque (percent).
 - 5) Motor speed (rpm).
 - 6) Set point frequency (Hz).
 - d. Remote Indication Interface: A minimum of Three programmable and one non-programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - 1) Motor running.
 - 2) Set point speed reached.
 - 3) Fault and warning indication (overtemperature or overcurrent).
 - 4) PID high- or low-speed limits reached.
6. Retain "PID Control Interface" Paragraph below if VFC controls interface directly with local controls and not through a BAS.

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7. PI Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
8. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms and energy usage. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.
 - a. Network Communications Ports: Ethernet and RS-422/485.
 - b. Embedded BAS Protocols for Network Communications: ASHRAE 135 BACnet Johnson Metasys N2 Modbus/Memobus Siemens System 600 APOGEE; protocols accessible via the communications ports.

S. Line Conditioning and Filtering

1. If input current distortion due to harmonic generation in VFCs is a concern, consult manufacturers for options available to mitigate harmonic distortion. Options may include dc bus link reactors, isolation transformers, active and passive harmonic filters, and 12- or 18-pulse phase-shifting input transformers. Retain first or second "Input Line Conditioning" Paragraph below if retaining "Harmonic Analysis Study and Report" Paragraph in "Submittals" Article, if a specific method of mitigation is not important, and if manufacturer is delegated responsibility to incorporate whatever mitigating means are necessary to comply with specified limitations. Otherwise, retain third "Input Line Conditioning" Paragraph and insert specific requirements. See "Harmonic Distortion" Article in the Evaluations for additional guidance.
2. Input Line Conditioning: Based on the harmonic analysis study and report, provide input filtering, as required, to limit TDD and THD(V) at the defined PCC per IEEE 519.
3. Input Line Conditioning: 5% min impedance.
4. Normally if the separation between motor and VFC is less than 100 feet (30 m), the motor is designed for use with VFC, low carrier frequencies are specified, or all three, then output filtering may not be an issue. However, if distances are over 100 feet (30 m) and high carrier frequencies are being used, controller output voltage can exceed motor pulse-withstand capability. Consult motor and VFC manufacturers to determine need for, and options available for, conditioning output voltage. Options may include line inductors, dV/dT filters, output reactors, and motor termination filters. Insert requirements in first paragraph below. See "Motor and VFC Compatibility" Article in the Evaluations for additional guidance.
5. Output Filtering: TBD based on field conditions.
6. If EMI/RFI generation in VFCs is a concern, consult manufacturers for options available to mitigate it. Specifying compliance with applicable standards and following proper installation methods will usually address EMI/RFI issues. Retain first "EMI/RFI Filtering" Paragraph below if a specific method of mitigation is not important and manufacturer is delegated responsibility to incorporate whatever mitigating means are necessary to comply with specified limitations. Otherwise, retain second "EMI/RFI

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Filtering" Paragraph and insert specific requirements. See "Electromagnetic Compatibility" Article in the Evaluations for additional guidance.

7. EMI/RFI Filtering: VFD's shall include EMI/RFI filters. The onboard RFI filter shall allow the entire VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted.

T. Bypass Systems

1. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
2. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.
3. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
 - a. Bypass Contactor: Load-break, IEC-rated contactor.
 - b. Input and Output Isolating Contactors: Non-load-break, IEC-rated contactors.
4. Bypass Contactor Configuration: Full-voltage (across-the-line) type.
 - a. NORMAL/BYPASS selector switch.
 - b. HAND/OFF/AUTO selector switch.
 - c. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
 - d. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - 1) Operating Voltage: Depending on contactor size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - 2) Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - e. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT control power source of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
 - 1) CPT Spare Capacity: 100 VA.
5. Overload Relays: NEMA ICS 2.

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- a. Bimetallic Overload Relays:
 - 1) Inverse-time-current characteristic.
 - 2) Class 20 tripping characteristic.
 - 3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - 4) Ambient compensated.
 - 5) Automatic resetting.
- b. NC isolated overload alarm contact.
- c. External overload reset push button.

U. Optional Features

- 1. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications, when overload protection activates.
 - a. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.
 - b. Configure to allow two motors to operate separately; operator selectable via local or remote switch or contact closures; single overload relay for both motors; separate output magnetic contactors for each motor.
 - c. Configure to allow two motors to operate simultaneously and in a lead/lag mode, with one motor operated at variable speed via the power converter and the other at constant speed via the bypass controller; separate overload relay for each controlled motor.
- 2. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.
- 3. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.
 - a. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
 - b. Remote digital operator kit.
 - c. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

V. Enclosures

- 1. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - a. Dry and Clean Indoor Locations: Type 1.

- b. Outdoor Locations: Type 3R.
 - c. Kitchen Wash-Down Areas: Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
2. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

W. Accessories

1. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
 - a. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, type.
 - 1) Pilot Lights: LED types;
2. Reversible NC/NO bypass contactor auxiliary contact(s) as required.
3. Control Relays: solid-state time-delay relays.
4. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - a. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
5. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4, Type 4X or Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
6. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R, Type 4X or Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
7. Cooling Fan and Exhaust System: For NEMA 250, Type 1 or Type 12; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120 -V ac; obtained from integral CPT.
8. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
9. Indicate quantities of spare control-wiring terminal blocks on Drawings.
10. Spare control-wiring terminal block; unwired.

X. Source Quality Control

1. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

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- a. Test each VFC while connected to its specified motor.
 - b. Verification of Performance: Rate VFCs according to operation of functions and features specified.
2. VFCs will be considered defective if they do not pass tests and inspections.
 3. Prepare test and inspection reports.

2.2 VFDS FOR FANS

- A. Subject to compliance with requirements, provide ABB or equal.
- B. Optional features
 1. Damper control circuit with end of travel feedback capability.
 2. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station, this password-protected input:
 - a. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
 - b. Forces VFC to operate motor, without any other run or speed command, at a field adjustable, preset speed.
 - c. Forces VFC to operate motor, without any other run or speed command, at a field-adjustable, preset speed.
 - d. Forces VFC to transfer to Bypass Mode and operate motor at full speed.
 - e. Causes display of Override Mode on the VFC display.
 - f. Reset VFC to normal operation on removal of override signal automatically.

2.3 VFDS FOR PUMPS

- A. Basis of Design Product: Subject to compliance with requirements provide:
 1. IQpump Variable Frequency Drive (VFD) manufactured by Yaskawa America, Inc.
- B. VFD Description:
 1. VFD shall have a complete integrated pumping macro with pump-specific parameters allowing the operator to setup specific control values for a wide range of pumping applications such as constant pressure, constant flow, suction control, vacuum control and level control. VFD will automatically adjust pump operating conditions as the process variables change within the defined programmable pump settings while still maintaining optimum pump performance and protection.

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2. The VFD Controller can be configured for Simplex, Duplex, Triplex and Multiplex pump systems using one master VFD Controller with the ability to add up to an additional five lag pumps or control up to eight IQpump controllers in a Multiplex Network.

C. Indication:

1. VFD Shall include three independent multi-function analog inputs, individually selectable for 0-10 VDC, -10 to +10 VDC, 0-20 mA or 4-20 mA. Each input shall have a programmable bias and gain. The inputs shall be individually programmed for, but not limited to:
 - a. PID Set Point
 - b. PID Feedback
 - c. Pressure Level
 - d. Flow Level
 - e. Depth Level
2. VFD shall include eight independent multi-function digital terminals that can be set for sinking/sourcing and internal/external power supplies. The inputs shall be individually programmed for, but not limited to:
 - a. Hand – Off – Auto operation Selection
 - b. Detection of External Fault Condition
 - c. Remote Reset
 - d. Multi-step Speed Commands
 - e. Run Permissive
 - f. Floating Control
 - g. Check Valve input alarm/fault
 - h. High or low level Alarm/fault
 - i. High or Low input pressure Alarm/fault
 - j. High pressure alarm/fault
 - k. Pump pre-charge
3. VFD shall include one multi-function 32 kHz pulse train input that shall be programmed for, but to limited to:
 - a. PID Set Point
 - b. PID Feedback
4. VFD Shall include one fixed form “C” fault contact, two programmable multi-function form “A” contacts, and one programmable form “C” contact. These output relay contacts shall all be rated for 1A at 250 VAC and shall be programmed for, but not limited to:
 - a. Pump Fault
 - b. Low and High Pressure Detection

- c. Pump Over Cycling Detection
 - d. Loss of Prime Detection
 - e. Drive Fault
 - f. Over/Under Torque Detection
 - g. Not maintaining Set Point Detection
 - h. No Flow detection]
 - i. Thrust Bearing Start
 - j. Low Input Pressure
 - k. Low/High Flow Level
 - l. Anti-Jam Protection
 - m. De-scale Operation
5. VFD keypad shall provide plain language display readouts of output frequency in hertz, PI feedback in percent, pump speed in RPM, set point and feedback level in programmable engineering units (PSI, GPM, etc.), output voltage in volts, output current in amps, output power in kilowatts, D.C. bus voltage in volts, control terminal status, heatsink temperature in degrees and fault conditions in the selected keypad language.

D. Controls:

1. VFD shall include pump-specific application presets. The parameter presets can be used to help facilitate start-up. The presets will program all parameters and customer interfaces for a particular application (pump Down Level, Geothermal, Vertical Turbine) to reduce programming time.

E. Software Features:

1. Pump-specific firmware shall be embedded within the VFD controller. These pump-specific software functions and settings shall be standard as minimum. All control features, Alarms, and Faults shall be displayed in intuitive system pump terminology on the HOA keypad. Parameter codes with abbreviations are not acceptable.
 - a. Hand/Off/Auto Run operation from HOA Keypad without stopping (bumpless transfer). HOA Keypad to display current operational mode. Example: Off Mode, Hand Mode, Hand Mode reference, and Automatic Mode.
 - b. HOA Keypad can be configured to lock out "Hand Mode, Hand Mode Reference, and Automatic Mode.
 - c. Application Presets that automatically set all critical drive settings. Applications include Water Level Control, Geothermal Well Control, Vertical Turbine Control, and General Purpose Mode.
 - d. Full use of Real Time clock to time/date stamp faults and alarms and to provide for time/date based on/off control.
 - e. Auto Restart on complete power loss. If in Auto Mode without external run control for start/stop, the pump system will automatically restart to maintain set point and cycle through all safety & restart conditions.

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- f. Programmable Engineering units (PSI, GPM, LPH) for set point, feedback and parameter scaling. It is not acceptable to use percent of VFD parameters for pump level settings.
- g. Programmable start levels, sleep levels, stop levels with engineering units specific to pump application. Example: PSI, GPM, LPH, etc.
- h. Programmable scaling for feedback levels with feedback transducer loss protection based on level and delay time. Both of these functions shall be independent.
- i. Pump Quick Setup Menu for pump settings and startup.
- j. System Pre-Charge: Programmable settings in pump engineering units that allow for charging of the pump system prior to automatic mode. Dedicated pre-charge system level settings with programmable times. PI control is turned off and will enable automatically once operation is completed.
- k. Thrust Bearing: Programmable operation that will allow the pump motor to rapidly accelerate to a fixed speed with independent timers. PI control is turned off and will enable automatically once operation is completed.
- l. Programmable Low and High Pressure feedback settings with timers.
- m. Programmable pump over-cycling timer.
- n. Programmable Anti-Jam feature with cycle count and timer.
- o. Programmable Low City Pressure switch that will prohibit the drive from running when low incoming pressure is indicated by a pressure switch.
- p. Programmable Output Current Limit to protect the motor-pump system.
- q. Programmable parameter lockout feature to prevent parameter and set point changes.
- r. Programmable drive input Single Phase protection feature.
- s. Programmable Remote Drive Disable function that can put the system to sleep via a remote contact closure.
- t. Programmable Stop with Timer function to prevent starting into a back-spinning pump.
- u. Programmable alarms and faults for High and Low Water Level switches.
- v. Programmable Geothermal mode. A geothermal well facilitates heat transfer between the earth and a known system, such as space heating, electric power generation and food processing. The geothermal function has the ability to regulate the speed of the iQpump Controller based on an external temperature signal following a preset temperature-speed curve.
- w. Programmable Suction Pressure Control that will deviate from output pressure control when the pump inlet suction pressure drops beyond a settable point and control suction pressure.
- x. Programmable Vacuum Pressure Control that will deviate from output pressure control when the pump inlet vacuum increases beyond a settable point and regulate the vacuum pressure.
- y. Programmable Water Level control Pressure Control that will deviate from output pressure control when the well level drops below a settable point and regulate the well level.
- z. Programmable Feedback Wire Break detection function with selectable response.

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- aa. Programmable Lube Pump control to enable pre-lubricating the pump seals prior to starting.
- bb. Programmable Pre-Charge function to fill piping or storage tank before turning on the PI controller.
- cc. Programmable Flow Meter Control that can measure flow over time and store the data in non-volatile memory put the drive to sleep, control the drive to a flow set point, and check for high/low flow faults and alarms.
- dd. Programmable Utility Start function to prevent all drives in a system from starting at the same time to reduce peak currents.
- ee. Programmable low water & high water input settings.
- ff. Programmable Minimum Pump Speed to prevent pump damage caused by cavitation.
- gg. Programmable Alarm and Fault specifically for a thermostat placed on the pump house (volute) or inside of the pump motor.
- hh. Programmable Pump Motor heating level when stopped to control motor condensation.
- ii. Programmable No Flow or dead Head Pump Curve protection allowing for either settings in Hz, Engineering units (PSI, GPM, etc) or motor RPM.
- jj. Embedded Pump Controller Capability: In addition to the ability to follow an analog input related for speed control, the drive shall be able to operate in the following control modes:
 - 1) Simplex controller: The drive shall accept an input proportional to the process variable (flow, pressure, etc.). The drive shall accept direct keypad entry or analog input entry of the desired set point. The Drive shall utilize PI set point control to continuously modulate the output speed to maintain set point.
 - 2) Multiplex controller: The drive shall be capable of being operated as a multiplex controller operating as in simplex mode with same system inputs but provide lead-lag control of up to 6 pumps such that the set point is controlled via operation of one or more pumps while alternating pumps to evenly distribute operation time. System master controller to have independent control settings in engineering units for pump system to turn on and off. System stabilization to also be included.
 - 3) Dedicated Pump Alarms & Messages: Flashing LED or abbreviated codes are not acceptable:
 - a) Low Feedback
 - b) High Feedback
 - c) Low Water
 - d) Pump Over Cycling Detection
 - e) No Flow Detection
 - f) Loss of Prime Detection
 - g) Pump Fault

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- h) Motor Thermostat Fault
 - i) Pre-Charge Mode Active
 - j) Thrust Bearing Active
 - k) Start Mode Active
 - l) Sleep Mode Active
 - m) Anti-Jam Active
 - n) Feedback Loss Detection
- 4) VFD is supplied with a pump controller SCADA PC program that allows the users to program pump parameter settings, drive commissioning, and diagnose system conditions. As standard, the PC program should have the following functions:
- a) Online PID tuner with graphical representation.
 - b) System trending recorder (Oscilloscope) that allows a minimum of 6 signals to be graphed with a playback mode.
 - c) Run Status Page with pump visual graphics allowing for all pump functions such as, set points, feedback levels, faults, alarms, and Multiplex operation to be displayed with actual running data.
 - d) Programming parameter page for all pump specific parameters allowing for pre-setup, online changes, and complete upload/download of settings.
 - e) Pump Setup Wizard to be a graphical interface configured to ask questions to the operator for pump parameter settings based on pump application.
 - f) Pump Simulator with graphical interface allowing for training of engineers, service and start up technicians that will emulate the actual pump running conditions based on pump parameters settings, set point and feedback levels.
 - g) Program shall be able to communicate to pump controller via RS232/485, and Ethernet TCP/IP.
- 5) PC tool shall be automatically updated via the Internet.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, insert Project-specific conditions, and other conditions affecting performance.

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- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HARMONIC ANALYSIS STUDY

- A. Perform a harmonic analysis study (for all projects on utility company power with motors over 30 HP and all projects on cogeneration power with motors greater than 20 HP) to identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels.
- B. Prepare a harmonic analysis study and report complying with IEEE 399 and NETA Acceptance Testing Specification. The result of the analysis shall determine if additional power quality improvement measures should be included in the proposal to meet the THD recommendations of IEEE 519. The PCC shall be at the primary side of the main distribution transformer.

3.3 INSTALLATION

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Division 03 Section. ". "
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

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4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
 1. Curbs and roof penetrations are specified in Division 07 Section "Roof Accessories."
 2. Structural-steel channels are specified in Division 23 Section "Hangers and Supports for Mechanical Systems."
- E. Seismic Bracing: Comply with requirements specified in Division 23 Section "Vibration and Seismic Controls for Mechanical Systems."
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- G. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- H. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- J. Comply with NECA 1.

3.4 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each VFC with engraved nameplate.
 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

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3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).

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5. Test each motor for proper phase rotation.
 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. VFCs will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

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3.9 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

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.
- B. Vibration, seismic, wind & flood criteria for this vendor is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section in its entirety.

1.2 SUMMARY

- A. Section Includes:
 - 1. Flexible, ball-joint, packed expansion joints.
 - 2. Slip-joint packed expansion joints.
 - 3. Expansion-compensator packless expansion joints.
 - 4. Metal-bellows packless expansion joints.
 - 5. Pipe loops and swing connections.
 - 6. Alignment guides and anchors.

1.3 DEFINITIONS

- A. EJMA: Expansion Joint Manufacturer's Association.

1.4 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.
- C. All piping shall be installed in such a manner as to allow for expansion and contraction by means of offsets, pipe loops or expansion joints without causing undue stress in piping or at connections to equipment. Where pipe offsets or loops are not detailed or dimensioned on drawings, the contractor is to submit calculations to show that the stress range of the pipe does not exceed 15000 psi.
- D. Expansion joints shall be the type, manufacturer and model number as indicated on drawings. Where no type or model number is indicated, any of the expansion joints described below may be used if they are suitable for design and operating conditions of temperature pressure and movement except that Bellow Expansion pressures over 15 psig for all sizes or (b) hydronic systems operating over 200 psig operating pressure in all sizes.

- E. All expansion joints shall be designed so that pressure containing components are in accordance with requirements as specified in ANSI B-31.1 Power piping.
- F. All expansion joints and expansion compensators shall have a metal nameplate permanently attached bearing inscription of size, type, pressure rating, allowable movement, year of fabrication and manufacturers identification number.
- G. All pipe lines containing expansion joints shall be guided in accordance with expansion joint manufacturers instructions as substantiated by data in manufacturers catalog or separate data furnished with submittal drawings.
- H. Contractor, in conjunction with information provided by expansion joint manufacturer is to submit anchor load calculations for both operating and hydrostatic test conditions.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by a qualified professional engineer hired by the company responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing anchors, guides, expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Calculate number of guides and exact locations, based on EJMA guidelines. Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.
- D. Product Certificates: For each type of expansion joint, from manufacturer.
- E. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. ASME Boiler and Pressure Vessel Code: Section IX.
- B. Manufacturer shall be member of EJMA (Expansion Joint Manufacturer's Association).

PART 2 - PRODUCTS

2.1 PACKED EXPANSION JOINTS

A. Flexible, Ball-Joint, Packed Expansion Joints:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hyspan Type N Style 2 or comparable product by one of the following:
 - a. Advanced Thermal Systems, Inc.
 - b. BARCO Corp.
2. Standards: ASME Boiler and Pressure Vessel Code: Section II, "Materials"; and ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting. FM approved.
3. Material: Carbon-steel assembly with asbestos-free ductile iron seal..
4. Design: For 360-degree rotation and angular deflection. Bolted Retainer.
5. Minimum Pressure Rating: 250 psig at 400 deg F (1725 kPa at 204 deg C).
6. Angular Deflection for NPS 6 (DN 150) and Smaller: 30 degree minimum.
7. Angular Deflection for NPS 8 (DN 200) and Larger: 15 degree minimum.
8. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
9. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

B. Slip-Joint Packed Expansion Joints: [In Steam Riser - Access Required]

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hyspan Series 6500 or comparable product by one of the following:
 - a. Adscos Manufacturing LLC.
 - b. Advanced Thermal Systems, Inc.
2. Standard: ASTM F 1007.
3. Material: Carbon steel with asbestos-free PTFE packing.
4. Design: With internal guide and injection device for repacking under pressure. Include drip connection if used for steam piping.
5. Configuration: Single joint with base or double joint with base class(es) unless otherwise indicated.
6. End Connections: Flanged or weld ends to match piping system. Lifting lug on 6" and larger.

2.1 PACKED EXPANSION JOINTS

A. Flexible, Ball-Joint, Packed Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Advanced Thermal Systems, Inc.
 - b. Hyspan Precision Products, Inc.
3. Standards: ASME Boiler and Pressure Vessel Code: Section II, "Materials"; and ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
4. Material: Carbon-steel assembly with asbestos-free composition packing.
5. Design: For 360-degree rotation and angular deflection.
6. Minimum Pressure Rating: [250 psig at 400 deg F (1725 kPa at 204 deg C)]
7. Angular Deflection for NPS 6 (DN 150) and Smaller: 30 degree minimum.
8. Angular Deflection for NPS 8 (DN 200) and Larger: 15 degree minimum.
9. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
10. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

B. Slip-Joint Packed Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product** indicated on Drawings or comparable product by one of the following:
 - a. Adscos Manufacturing LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Hyspan Precision Products, Inc.
3. Standard: ASTM F 1007.
4. Material: Carbon steel with asbestos-free PTFE packing.
5. Design: With internal guide and injection device for repacking under pressure. Include drip connection if used for steam piping.
6. Configuration: **Single joint, Single joint with base, and double joint with base class(es)** unless otherwise indicated.
7. End Connections: Flanged or weld ends to match piping system.

2.2 PACKLESS EXPANSION JOINTS

A. Metal, Expansion-Compensator Packless Expansion Joints: [COPPER 1 1/2" AND SMALLER]

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hyspan Series 8500 or comparable product by one of the following:
 - a. Metraflex, Inc.
 - b. Senior Flexonics Pathway.

2. Minimum Pressure Rating: 200 psig unless otherwise indicated.
3. Configuration for Copper Tubing: Two-ply, phosphor-bronze bellows with copper pipe ends.
 - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded.
4. Configuration for Steel Piping: Minimum Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or Welded at Contractor's option.

B. Metal-Bellows Packless Expansion Joints: [4" AND ABOVE METAL PIPE ONLY]

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hyspan Series 3500 or comparable product by one of the following:
 - a. Adscio Manufacturing LLC.
 - b. Senior Flexonics Pathway.
2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated bellows with external housing.
4. Minimum Pressure Rating: [150 psig at 500°F] [300 psig at 500°F] unless otherwise indicated.
5. Configuration: Single joint with base or double joint with base, as required, class(es) unless otherwise indicated.
6. Expansion Joints for Copper Tubing: [Single] [Single- or multi] [Multi]-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded at Contractor option.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint or threaded at Contractor option.
 - c. 4" Maximum in copper.
7. Expansion Joints for Steel Piping: Multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged.

- C. Metal-Bellows Packless Expansion Joints for Seismic Application:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Hyspan Series 3500 IS or comparable product by one of the following:
 - a. Adsko Manufacturing LLC.
 - b. Metraflex, Inc.
 - c. Senior Flexonics Pathway.
 2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 3. Type: Circular, corrugated bellows with external housing.
 4. Minimum Pressure Rating: [175 psig (1200 kPa)] unless otherwise indicated.
 5. Configuration: Single joint class(es) unless otherwise indicated.
 6. Expansion Joints for Steel Piping: Multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged.

2.2 PACKLESS EXPANSION JOINTS

- A. Metal, Expansion-Compensator Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Adsko Manufacturing LLC.
 - b. Flexicraft Industries.
 - c. Flex Pression Ltd.
 - d. Flex-Weld, Inc.
 - e. Hyspan Precision Products, Inc.
 - f. Metraflex, Inc.
 - g. Senior Flexonics Pathway.
 - h. Unaflex.
 - i. Unisource Manufacturing, Inc.
 3. Minimum Pressure Rating: [175 psig (1200 kPa)] unless otherwise indicated.
 4. Configuration for Copper Tubing: Two-ply, phosphor-bronze bellows with copper pipe ends.
 - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: **Solder joint**
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded.

5. Configuration for Steel Piping: Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): **Weld**.

- B. Rubber, Expansion-Compensator Packless Expansion Joints:
 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. General Rubber Corporation.
 - e. Mason Industries, Inc.; Mercer Rubber Co.
 - f. Proco Products, Inc.
 - g. Tozen Corporation.
 - h. Unaflex.
 - i. Unisource Manufacturing, Inc.
 3. Material: Twin reinforced-rubber spheres with external restraining cables.
 4. Minimum Pressure Rating: [150 psig at 170 deg F (1035 kPa at 77 deg C)] unless otherwise indicated.
 5. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

- D. Flexible-Hose Packless Expansion Joints:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex Pression Ltd.
 - d. Metraflex, Inc.
 - e. Unisource Manufacturing, Inc.
 3. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 4. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

5. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with **solder-joint** end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.
 - b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 500 psig at 450 deg F (3450 kPa at 232 deg C) ratings.

6. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2070 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F (2890 kPa at 21 deg C) and 315 psig at 450 deg F (2170 kPa at 232 deg C) ratings.

7. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 325 psig at 600 deg F (2250 kPa at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 515 psig at 600 deg F (3550 kPa at 315 deg C) ratings.

8. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with weld end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F (1900 kPa at 21 deg C) and 200 psig at 600 deg F (1380 kPa at 315 deg C) ratings.

9. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Carbon-steel fittings with weld end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F (860 kPa at 21 deg C) and 90 psig at 600 deg F (625 kPa at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F (1130 kPa at 21 deg C) and 120 psig at 600 deg F (830 kPa at 315 deg C) ratings.

10. Expansion Joints for Steel Piping NPS 14 (DN 350) and Larger: Carbon-steel fittings with weld end connections.
 - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F (1130 kPa at 21 deg C) and 120 psig at 600 deg F (830 kPa at 315 deg C) ratings.

E. Metal-Bellows Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Adesco Manufacturing LLC.
 - b. American BOA, Inc.
 - c. Badger Industries, Inc.
 - d. Expansion Joint Systems, Inc.
 - e. Flex-Hose Co., Inc.
 - f. Flexicraft Industries.
 - g. Flex Pression Ltd.
 - h. Flex-Weld, Inc.
 - i. Flo Fab inc.
 - j. Hyspan Precision Products, Inc.
 - k. Metraflex, Inc.
 - l. Proco Products, Inc.
 - m. Senior Flexonics Pathway.
 - n. Tozen Corporation.
 - o. Unaflex.
 - p. Unisource Manufacturing, Inc.
 - q. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.
 - r. U.S. Bellows, Inc.
 - s. WahlcoMetroflex.
3. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
4. Type: Circular, corrugated bellows with external tie rods.
5. Minimum Pressure Rating: [175 psig (1200 kPa)] unless otherwise indicated.
6. Configuration: Single joint, Single joint with base, and double joint with base class(es) unless otherwise indicated.
7. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint.
 - c. End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.

8. Expansion Joints for Steel Piping: Single- or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Weld.

F. Rubber Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Flex-Weld, Inc.
 - e. Garlock Sealing Technologies.
 - f. General Rubber Corporation.
 - g. Mason Industries, Inc.; Mercer Rubber Co.
 - h. Metraflex, Inc.
 - i. Proco Products, Inc.
 - j. Red Valve Company, Inc.
 - k. Tozen Corporation.
 - l. Unaflex.
 - m. Unisource Manufacturing, Inc.
3. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
4. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
5. Arch Type: Single or multiple] arches with external control rods.
6. Spherical Type: Single or multiple spheres with external control rods.
7. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): [150 psig (1035 kPa) at 220 deg F (104 deg C)]
8. Minimum Pressure Rating for NPS 5 and NPS 6 (DN 125 and DN 150): [140 psig (966 kPa) at 200 deg F (93 deg C)]
9. Minimum Pressure Rating for NPS 8 to NPS 12 (DN 200 to DN 300): [140 psig (966 kPa) at 180 deg F (82 deg C)].
10. Material for Fluids Containing Acids, Alkalies, or Chemicals: [BR] [CSM] [EPDM].
11. Material for Fluids Containing Gas, Hydrocarbons, or Oil: [Buna-N] [CR].
12. Material for Water: [BR] [Buna-N] [CR] [CSM] [EPDM] [NR].
13. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.3 GROOVED-JOINT EXPANSION JOINTS

- A. **Manufacturers:** Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
- B. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Anvil International, Inc.
 - 2. Shurjoint Piping Products.
 - 3. Victaulic Company.
- C. **Description:** Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- D. **Standard:** AWWA C606, for grooved joints.
- E. **Nipples:** [**Galvanized,**]ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.
- F. **Couplings:** [Five] [Seven] [10] [12], flexible type for steel-pipe dimensions. Include ferrous housing sections, [Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water] [EPDM gasket suitable for cold and hot water], and bolts and nuts.

2.4 ALIGNMENT GUIDES AND ANCHORS

- A. **Alignment Guides:**
 - 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Hyspan Series 9500 or comparable product by one of the following:
 - a. Adscos Manufacturing LLC.
 - b. Metraflex, Inc.
 - c. Senior Flexonics Pathway.
 - d. U.S. Bellows, Inc.
 - 2. **Description:** Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.
- B. **Anchor Materials:**
 - 1. **Steel Shapes and Plates:** ASTM A 36/A 36M.
 - 2. **Bolts and Nuts:** ASME B18.10 or ASTM A 183, steel hex head.
 - 3. **Washers:** ASTM F 844, steel, plain, flat washers.

4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

2.4 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Adesco Manufacturing LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Senior Flexonics Pathway.
 - i. Unisource Manufacturing, Inc.
 - j. U.S. Bellows, Inc.
3. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.

4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install packed-type expansion joints with packing suitable for fluid service.
- C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least four pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.
- E. Where four fittings between riser and branch connection or terminal is not physically possible, install expansion joints in riser.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install guide(s) on each side of pipe expansion fittings and loops, as required. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

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SECTION 230517

SLEEVES AND SLEEVE SEALS FOR MECHANICAL PIPING

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.
- B. Vibration and wind criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Noise criteria for this section is referenced in specification section 230548.1. Vendor/manufacturer/contractor is responsible for this section 230548.1 in its entirety.

1.2 SUMMARY

- A. Section includes:
 - 1. Sleeves.
 - 2. Riser-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Sleeves and sleeve seals for plumbing piping systems shall be installed in compliance with the requirements of Section 230548.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

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PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 RISER-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

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PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide required annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/2-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.

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1. Install fittings that are large enough to provide 1/2-inch annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:

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1. Exterior Concrete Walls above Grade:
 - a. All Piping: Cast-iron wall sleeves, Galvanized-steel wall sleeves, Galvanized-steel-pipe sleeves, Sleeve-seal fittings.
2. Exterior Concrete Walls below Grade:
 - a. All piping: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system, Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
 - a. All piping: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system, Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
 - a. All piping 18 gauge: Galvanized-steel-pipe sleeves.
5. Interior Partitions:
 - a. All piping 18 gauge: Galvanized-steel-pipe sleeves.

END OF SECTION

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SECTION 230518

ESCUTCHEONS FOR HVAC PIPING

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.
- B. Vibration and wind criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Noise criteria for this section is referenced in specification section 230548.1. Vendor/manufacturer/contractor is responsible for this section 230548.1 in its entirety.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

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- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

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- i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with exposed-rivet hinge.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with rough-brass finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with exposed-rivet hinge.
2. Escutcheons for Existing Piping:
- a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
 - i. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

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SECTION 230519

METERS AND GAGES FOR HVAC PIPING

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. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Thermowells.
5. Dial-type pressure gages.
6. Gage attachments.
7. Test plugs.
8. Test-plug kits.
9. Sight flow indicators.
10. Orifice flowmeters.
11. Pitot-tube flowmeters.
12. Turbine flowmeters.
13. Venturi flowmeters.
14. Vortex-shedding flowmeters.
15. Impeller-turbine, thermal-energy meters.
16. Ultrasonic, thermal-energy meters.

B. Related Sections:

1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.
2. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Product Certificates: For each type of meter and gage, from manufacturer.
- D. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All meters and Gauges shall be mercury-free type.

2.2 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss or comparable product by one of the following:
 - 1. Ashcroft, Inc.
 - 2. Ernst Flow Industries.
 - 3. Marsh Bellofram.
 - 4. Miljoco Corporation.
 - 5. Nanmac Corporation.
 - 6. Noshok.
 - 7. Palmer Wahl Instrumentation Group.
 - 8. REOTEMP Instrument Corporation.
 - 9. Tel-Tru Manufacturing Company.
 - 10. Terice, H. O. Co.
 - 11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 12. Weiss Instruments, Inc.
 - 13. WIKA Instrument Corporation - USA.
 - 14. Winters Instruments - U.S.

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- C. Standard: ASME B40.200.
- D. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.
- E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- F. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- G. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- H. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.
- I. Window: Plain glass.
- J. Ring: Stainless steel.
- K. Element: Bimetal coil.
- L. Pointer: Dark-colored metal.
- M. Accuracy: Plus or minus 1.5 percent of scale range.

2.3 FILLED-SYSTEM THERMOMETERS

- A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss or comparable product by one of the following:
 - a. Ashcroft, Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Trerice, H. O. Co.
 - g. Weiss Instruments, Inc.
 - 3. Standard: ASME B40.200.
 - 4. Case: Sealed type, cast aluminum or drawn steel 6-inch nominal diameter.
 - 5. Element: Bourdon tube or other type of pressure element.

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6. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
12. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
13. Accuracy: Plus or minus 1 percent of scale range.

2.4 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Terice, H. O. Co.
3. Standard: ASME B40.200.
4. Case: Cast aluminum 6-inch nominal size.
5. Case Form: Back angle unless otherwise indicated.
6. Tube: Glass with magnifying lens and or red organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass or plastic.
9. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
10. Connector: 3/4 inch, with ASME B1.1 screw threads.

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11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss or comparable product by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
3. Standard: ASME B40.200.
4. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
5. Case Form: Adjustable angle unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid.
7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
8. Window: Glass.
9. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.5 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.6 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2 inch with ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2 inch with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.7 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Terice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.

- n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
- 3. Standard: ASME B40.100.
 - 4. Case: Liquid-filled type(s); cast aluminum or drawn steel 4-1/2-inch nominal diameter.
 - 5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 6. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 7. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 - 9. Pointer: Dark-colored metal.
 - 10. Window: Acrylic.
 - 11. Ring: Metal.
 - 12. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.8 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 pipe threads.
- C. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.9 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss or comparable product by one of the following:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trevice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.

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- C. Description: Test-station fitting made for insertion into piping tee fitting.
- D. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- E. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
- F. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- G. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.10 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Weiss or comparable product by one of the following:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- C. Furnish one test-plug kit containing two thermometers, one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- D. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- E. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- F. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- G. Carrying Case: Metal or plastic, with formed instrument padding.

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2.11 SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Dwyer or comparable product by one of the following:
 - 1. Archon Industries, Inc.
 - 2. Dwyer Instruments, Inc.
 - 3. Emerson Process Management; Brooks Instrument.
 - 4. Ernst Co., John C., Inc.
 - 5. Ernst Flow Industries.
 - 6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
 - 7. OPW Engineered Systems; a Dover company.
 - 8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
- C. Description: Piping inline-installation device for visual verification of flow.
- D. Construction: Bronze or stainless-steel body, with sight glass and paddle wheel indicator, and threaded or flanged ends.
- E. Minimum Pressure Rating: 150 psig.
- F. Minimum Temperature Rating: 200 deg F.
- G. End Connections for NPS 2 and Smaller: Threaded.
- H. End Connections for NPS 2-1/2 and Larger: Flanged.

2.12 FLOWMETERS

- A. Orifice Flowmeters:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Emerson Rosemount or Comparable product by one of the following:
 - a. ABB; Instrumentation and Analytical.
 - b. Preso Meters; a division of Racine Federated, Inc.
 - c. Emerson.

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2. Description: Flowmeter with sensor, hoses or tubing, fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.
 - a. Design: Differential-pressure-type measurement as required for fluid.
 - b. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
 - c. Minimum Pressure Rating: 300psig.
 - d. Minimum Temperature Rating: 250 deg F.
5. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected sensor and having 6-inch diameter, or equivalent, dial with fittings and copper tubing for connecting to sensor.
 - a. Scale: Gallons per minute.
 - b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
6. Display: Shows rate of flow, with register to indicate total volume in gallons.
7. Conversion Chart: Flow rate data compatible with sensor and indicator.
8. Operating Instructions: Include complete instructions with each flowmeter.

B. Thermal Mass Flowmeters

1. Basis-of-Design Product: Subject to compliance with requirements, provide Onicon F-5000 Series or comparable product by one of the following:
 - a. Emerson Process Management; Rosemount.
 - b. Veris Industries, Inc.
 - c. Onicon, Inc.
2. Description: Flowmeter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Insertion type; for inserting probe into piping and measuring flow directly in gallons per minute.
 - a. Design: Differential-pressure-type measurement for gas.
 - b. Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.

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- c. Minimum Pressure Rating: 500 psig.
 - d. Minimum Temperature Rating: 250 deg F.
5. Indicator: hand-held meter; either an integral part of sensor or a separate meter.
 6. Integral Transformer: for low-voltage power connection.
 7. Accuracy: Plus or minus [2] percent.
 8. Display: Shows rate of flow, with register to indicate total volume in gallons.
 9. Operating Instructions: Include complete instructions with each flowmeter.
 10. Provide optional remote display.

C. Turbine Flowmeters

1. Basis-of-Design Product: Subject to compliance with requirements, provide Oricon, Inc. or comparable product by one of the following:
 - a. AAB; Instrumentation and Analytical.
 - b. EMCO Flow Systems; a division of Spirax Sarco, Inc.
 - c. Onicon Incorporated.
2. Description: Flowmeter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Impeller turbine; for inserting into pipefitting or for installing in piping and measuring flow directly in gallons per minute.
 - a. Design: Device or pipe fitting with inline turbine and integral direct-redign scale for water.
 - b. Construction: Bronze or stainless steel body, with plastic turbine or impeller.
 - c. Minimum Pressure Rating: 400psi.
 - d. Minimum Temperature Rating: 180 deg F.
5. Indicator: Either an integral part of sensor or a separate meter.
6. Accuracy: Plus or minus 2 percent.
7. Display: Shows a rate of flow, with register to indicate total volume in gallons.
8. Operating Instructions: Include complete instructions with each flowmeter.
9. Provide the following accessories:
 - a. Remote display module.
 - b. BTU measurement system.

D. Vortex Flowmeters

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Rosemount or comparable product by one of the following:
 - a. ABB: Instrumentation and Analytical.
 - b. Eastech Flow Controls.
 - c. EMCO flow Systems; a division of Spirax Sarco, Inc.
 - d. Emerson Process Management; Rosemount.
2. Description: Flowmeter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gallons per minute.
 - a. Design: Flow obstruction device, vortex-measurement type for steam.
 - b. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
 - c. Minimum Pressure Rating: 1000psig.
 - d. Minimum Temperature Rating: 500 deg F (260 deg C).
 - e. Integral Transformer: For low-voltage power operation.
5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Accuracy: Plus or minus 0.75 percent for gases.
7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Operating Instructions: Include complete instructions with each flowmeter.
9. Provide the following options:
 - a. Remote flow computer.

2.13 THERMAL-ENERGY METERS

A. Impellar-Turbine, Thermal-Energy Meters

1. Basis-of-Design Product: Subject to compliance with requirements, Onicon Inc. or comparable product by one of the following:
 - a. Data Industrial Corp.
 - b. Hoffer Flow Controls, Inc.
 - c. ISTECH Corporation.
 - d. ONICON, Inc.

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2. Description: System with strainer, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
3. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.
 - a. Design: Total thermal-energy measurement.
 - b. Minimum Pressure Rating: 400 psig.
 - c. Minimum Temperature Range: 40 to 250 deg F.
4. Temperature Sensors: Insertion-type transducer.
5. Indicator: Solid-state, integrating –type meter; for wall mounting.
 - a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
 - b. Battery Pack: Five-year lithium battery.
6. Accuracy: Plus or minus 2 percent.
7. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.
8. Strainer: Full size of main line piping.
9. Operating Instructions: Include complete instructions with each thermal-energy meter system.

B. Ultrasonic, Thermal-Energy Meters

1. Basis-of-Design Product: Subject to compliance with requirements, provide Flexim or comparable product by one of the following:
 - a. EMCO Flow Systems; a division of Spirax Sarco, Inc.
 - b. Siemens Energy & Automation, Inc.
 - c. Flexim.
2. Description: Meter with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
3. Flow Sensor: Transit-time ultrasonic type with transmitter.
4. Temperature Sensors: Insertion-type or strap-on transducer as indicated.
 - a. Solid-state, integrating-type meter.
 - b. Data Output: Six-digit electro-mechanical counter with readout in kilowatts per hour or British thermal units.
 - c. Battery Pack: Five-year lithium battery.

5. Accuracy: Plus or minus 1 percent.
6. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.
7. Operating Instructions: Include complete instructions with each thermal-energy meter system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- I. Install remote-mounted pressure gages on panel.
- J. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- K. Install valve and syphon fitting in piping for each pressure gage for steam.
- L. Install test plugs in piping tees.
- M. Install flow indicators in piping systems in accessible positions for easy viewing.

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- N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- O. Install flowmeter elements in accessible positions in piping systems.
- P. Install wafer-orifice flowmeter elements between pipe flanges.
- Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
- R. Install permanent indicators on walls or brackets in accessible and readable positions.
- S. Install connection fittings in accessible locations for attachment to portable indicators.
- T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
- U. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler.
 - 3. Two inlets and two outlets of each cooling tower.
 - 4. Inlet and outlet of each hydronic coil in air-conditioning units.
 - 5. Two inlets and two outlets of each hydronic heat exchanger.
 - 6. Inlet and outlet of each thermal-storage tank.
 - 7. Outside-, return-, supply-, and mixed-air ducts.
 - 8. Where indicated on drawings
- V. Install pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each hot-water and condenser-water connection.
 - 3. Suction and discharge of each pump.
 - 4. Where indicated on plans and flow diagrams.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.

- D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic zone shall be the following:
 - 1. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- C. Thermometers at inlets and outlets of each cooling tower shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- D. Thermometers at inlet and outlet of each hydronic coil in air-conditioning units shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- E. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- F. Thermometers at inlet and outlet of each hydronic heat-recovery unit shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- G. Thermometers at inlet and outlet of each thermal-storage tank shall be the following:
 - 1. Direct-mounted, metal-case, vapor-actuated type.
- H. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be the following:

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1. Direct-mounted, metal-case, vapor-actuated type.

I. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Condenser-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C).

B. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C).

C. Scale Range for Air Ducts: 0 to 150 deg F (Minus 20 to plus 70 deg C).

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be the following:

1. Liquid-filled Solid-front, pressure-relief direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be the following:

1. Liquid-filled Solid-front, pressure-relief direct-mounted, metal case.

C. Pressure gages at suction and discharge of each pump shall be the following:

1. Liquid-filled Solid-front, pressure-relief direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Condenser-Water Piping: 0 to 250 psi.

B. Scale Range for Heating, Hot-Water Piping: 0 to 250 psi.

3.8 FLOWMETER SCHEDULE

A. Flowmeters for Condenser-Water Piping: Turbine type.

B. Flowmeters for Heating, Hot Water Piping: Turbine type.

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- C. Meters for Natural Gas or Compressed Air Piping: Thermal Mass Flowmeter.

3.9 THERMAL-ENERGY METER SCHEDULE

- A. Thermal-Energy Meters for Condenser-Water Piping: Impeller-turbine type.
- B. Thermal-Energy Meters for Heating, Hot-Water Piping less than 200 deg F: Impeller-turbine type.

END OF SECTION

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SECTION 230523

GENERAL-DUTY VALVES FOR HVAC PIPING

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.
- B. Vibration and wind criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Noise criteria for this section is referenced in specification section 230548.1. Vendor/manufacturer/contractor is responsible for this section 230548.1 in its entirety.

1.2 SUMMARY

- A. Section includes:
 - 1. Bronze ball valves.
 - 2. High-performance butterfly valves.
 - 3. Balancing valves.
 - 4. Gate valves.
 - 5. Globe valves.
 - 6. Lubricated plug valves.
 - 7. Chainwheels.
- B. Related sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.
 - 3. Division 23 Section "Above Ground & Exposed High Temperature Hot Water Piping".

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1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.

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6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
 - C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles and drawings for applications of valves.
- B. Furnish and install valves shown on the drawings, specified herein and/or necessary for the control and easy maintenance of all piping and equipment. All valves shall be first quality of one of the listed manufacturers, shall have proper clearances, and shall be tight at the specified test pressure. Each valve shall have the maker's name or brand, the figure or list number and guaranteed ANSI working pressure cast on the body and cast or stamped on the bonnet, or shall be provided with other means of easy identification. All valves of one type (gate, ball butterfly) shall be the product of one manufacturer for that type of valve.
- C. All gate and globe valves shall be suitable for repacking under pressure. Regardless of service, valves shall not be designated for less than 125 pounds per square inch steam working pressure.
- D. Use ball and butterfly valves for shut-off duty. Gate valves shall be used for steam system shut off duty where ball and butterfly valves may not be practical by pressure/temperature or local authority having jurisdiction.
- E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
 2. Handwheel: For valves other than quarter-turn types.

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3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller except plug valves.
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 10 plug valves, for each size square plug-valve head.
 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- H. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- I. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Grooved: With grooves according to AWWA C606.
 3. Solder Joint: With sockets according to ASME B16.18.
 4. Threaded: With threads according to ASME B1.20.1.
- J. Valve Bypass and Drain Connections: MSS SP-45.
- 2.2 BRONZE BALL VALVES
- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim up to 2 ½":
1. Manufacturers: Appollo 77-100 series by Conbraco Industries Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).

- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: RPTFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

2.3 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves 3" and up:

1. Manufacturers: Subject to compliance with requirements, provide Jamesbury figure 815L-11-2236TT available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper Cameron Valves; a division of Cooper Cameron Corp.
 - b. Crane Co.; Crane Valve Group; Flowseal.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Grinnell win series.
 - e. Keystone.
 - f. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig (1965 kPa) at 100 deg F (38 deg C).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Stainless steel.
 - h. Service: Bidirectional.
 - i. Multi-position (throttling) type operators with memory stop and position lock.
 - j. For valves 6" and larger, operators shall be enclosed self-locking worm gear type, waterproof and factory lubricated.
 - k. Operator shall have built in position indicators.
 - l. Manufacturer shall certify compliance with bubble tight shutoff requirements at full rated design pressure when flanged and at a differential pressure not less than

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the design working pressure and temperature specified with the downstream flange removed with flow in either direction.

- m. Valves used for balancing shall be certified suitable for continuous throttling service at a position thirty-five (35%) percent open.
- n. Butterfly valves installed in horizontal piping shall be mounted with the stem in the horizontal position and rotation so that the bottom of the disc lifts in direction of flow.

B. Class 300, Single-Flange, High-Performance Butterfly Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide Jamesbury fly 830-11-22-HMBT available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. Bray Controls; a division of Bray International.
- c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
- d. Crane Co.; Crane Valve Group; Flowseal.
- e. Crane Co.; Crane Valve Group; Stockham Division.
- f. DeZurik Water Controls.
- g. Hammond Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Tyco Valves & Controls; a unit of Tyco Flow Control.

- 2. Description:

- a. Standard: MSS SP-68.
- b. CWP Rating: 720 psig (4965 kPa) at 100 deg F (38 deg C).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: Carbon steel, cast iron, or ductile iron.
- e. Seat: Reinforced PTFE or metal.
- f. Stem: Stainless steel; offset from seat plane.
- g. Disc: Stainless steel.
- h. Service: Bidirectional.

2.4 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Bronze Disc up to 2 ½":

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1. Manufacturers: Subject to compliance with requirements Stockham Fig B321, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Kitz Corporation.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Red-White Valve Corporation.
- h. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig (2070 kPa). Max op pressure usage: 15 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

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2.5 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats 3" and larger:

1. Manufacturers: Subject to compliance with requirements, Stockham Figure G-931 available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Kitz Corporation.
- e. Legend Valve.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Powell Valves.
- i. Red-White Valve Corporation.
- j. Sure Flow Equipment Inc.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. 2-1/2" to 12", CWP Rating: 200 psig. Max op pressure = 150 psig
- c. 14" to 24", CWP Rating: 150 psig. Max op pressure = 150 psig
- d. Body Design: Clear or full waterway.
- e. Body Material: ASTM A 126, gray iron with bolted bonnet.
- f. Ends: Flanged.
- g. Trim: Bronze.
- h. Gasket: Asbestos-free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.

- c. NPS 14 to NPS 24, CWP Rating: 150 psig.
- d. Body Design: Clear or full waterway.
- e. Body Material: ASTM A 126, gray iron with bolted bonnet.
- f. Ends: Flanged.
- g. Trim: Composition.
- h. Seat Ring: Bronze.
- i. Disc Holder: Bronze.
- j. Disc: PTFE or TFE.
- k. Gasket: Asbestos free.

2.6 IRON, CENTER-GUIDED SILENT CHECK VALVES

A. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

- 1. Manufacturers: Subject to compliance with requirements, Mueller Figure 101 MAP available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. APCO Willamette Valve and Primer Corporation.
 - c. Crispin Valve.
 - d. DFT Inc.
 - e. Flo Fab Inc.
 - f. GA Industries, Inc.
 - g. Hammond Valve.
 - h. Metraflex, Inc.
 - i. Milwaukee Valve Company.
 - j. Mueller Steam Specialty; a division of SPX Corporation.
 - k. NIBCO INC.
 - l. Spence Strainers International; a division of CIRCOR International.
 - m. Sure Flow Equipment Inc.
 - n. Val-Matic Valve & Manufacturing Corp.
 - o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-125.
 - b. Up to 3", CWP Rating: 225 psig Max op pressure = 150 psig
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer.
 - e. Seat: Bronze.

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- B. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat 4" and larger:
1. Manufacturers: Subject to compliance with requirements, Mueller Figure 105 MAP available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 250 psig.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Style: Compact wafer.
 - f. Seat: Bronze.
- C. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat 4" and larger:
1. Manufacturers: Subject to compliance with requirements, Mueller Figure 105 MAP available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. 4" to 12", CWP Rating: 400 psig. Max op pressure = 150 psig.
 - c. 14" to 30", CWP Rating: 150 psig.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Style: Globe, spring loaded.
 - f. Ends: Flanged.
 - g. Seat: Bronze.

2.7 BRONZE GATE VALVES

- A. Class 150, RS Bronze Gate Valves up to 3":

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1. Manufacturers: Subject to compliance with requirements, provide Stockham Figure B-120 available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig. Max op pressure 150 psig
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.8 IRON GATE VALVES

A. Class 125, OS&Y, Iron Gate Valves, 4" and above:

1. Manufacturers: Subject to compliance with requirements, provide Stockham Figure 623 available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Flo Fab Inc.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.

k. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.

2.9 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc up to 2 ½":

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Hammond Valve.
- c. Kitz Corporation.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Powell Valves.
- g. Red-White Valve Corporation.
- h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- i. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 300 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron

2.10 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves 3" and above:

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1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Powell Valves.
- i. Red-White Valve Corporation.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- k. Zy-Tech Global Industries, Inc.

2. **Description:**

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves 3" and above:

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. **Description:**

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 500 psig.

- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

2.11 LUBRICATED PLUG VALVES

A. Class 125, Lubricated Plug Valves with Threaded Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide Walworth Figure 1796 available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
 - b. Homestead.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - e. Pattern: Regular.
 - f. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Lubricated Plug Valves with Flanged Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide Walworth Figure 1797 (3" to 5") or Figure 1707 (6" to 12") available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
 - b. Homestead.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.

- e. Pattern: Regular.
- f. Plug: Cast iron or bronze with sealant groove.

2.12 COMBINATION VALVES

- A. Combination valve piping packages where indicated on drawings, will include an inlet valve, a modulating 2- way or 3-way control valve (furnished by the BMS Contractor for installation under this section) with actuator and an outlet valve.
- A. At cooling coils, heating coils, re-heat coils, domestic water heater, the coil inlet valve shall incorporate an isolation function, an accessible stainless steel 20 mesh strainer with blowdown capacity, and a PT port for pressure gauge and thermometer probes.
 - 1. Inlet valves ½" to 2" shall be of bronze, rated at 300 psig, with FNPT ends, similar to Griswold model Isolator S. The isolation shall be of the ball valve type.
 - 2. Inlet valves 2 ½" to 6" shall be ASTM A126-61T Class 30 iron, rated at 300 psi, with 150# flanges, similar to Griswold model 3650. The isolation shall be of the butterfly valve type.
- B. The coil outlet valve shall incorporate an isolation function, a flow limiter, and PT ports for flow meters, pressure gauges, and thermometer probes.
 - 1. Outlet valves ½" to 2" shall be of an ASTM brass body rated at no less than 400 psi at 250 degrees F similar to Griswold Isolator R. Available flow rated shall be from 0.33 GPM to 44.0 GPM. Isolator R series valve body design shall allow inspection or removal of cartridge without disturbing piping connections. Isolation shall be of the ball valve type Provide Union B at coil outlet with manual vent and PT port.
 - 2. Outlet valves 2-1/2" to 6" shall be ASTM A126-61T Class 30 iron, rated at 300 psig, with 150# flanges, similar to Griswold Model 3650. The isolation shall be of the butterfly valve type. Provide Union B at coil outlet with manual vent and PT port.
- C. Accessories
 - 1. A portable meter kit shall be provided for flow verification and shall have a range of – 14.7 to 150 psi, and end connections compatible with the pressure/temperature test ports on the flow limiter valve body.
 - 2. A quantity of two probe type portable pressure gauges shall be provided.
 - 3. A quantity of two probe type portable temperature gauges shall be provided.
 - 4. All items shall come tagged per unity designation.

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2.13 RADIATION BALANCING VALVES

A. Manual Balancing Valves.

1. Manufacturers: Subject to compliance with requirements, provide Bell & Gosset Model AU Ultra Setter Compact Valves, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Griswold.
 - b. Apollo.
2. Description:
 - a. Valve should maintain flow accuracy to within +/- 5% of desired flow rate for the entire control range up to 60 PSID. Valve should include two (2) pressure/temperature readout valves to allow measurement of differential pressure. Maximum flow setting should be set using a rotational flow setting motion and an externally adjustable dial with GPM scale.
 - b. Valve should feature an internal combination flow setting, differential pressure regulator, and modulating assembly. Differential pressure regulator should utilize an internal capillary tube to maintain supply-side pressure to the backside of the regulator, as well as a rolling rubber diaphragm seal to prevent unwanted flow from passing through the backside of the regulator to the discharge of the valve.
 - c. Valve body should be brass construction, rated for 360 psi maximum working pressure and 248°F maximum working temperature. Valve flow setting element should be brass and construction. Differential pressure control element should be PPS 40% glass with stainless steel spring and HNBR rubber diaphragm.
 - d. Valve should include integrated ball style isolation/shut off valve with stainless steel ball. Valve should include hanging ID tag for commissioning. Valve should include union tailpiece and union nut.

2.14 ORBIT VALVES

A. Manufacturer: Provide product by the following manufacturer:

1. Cameron Orbit Valves.

B. Description:

1. Model: Standard WCC Carbon Steel Body/Bonnet – Temp Range -20 to 500 deg F.
2. Class: ASME/ANSI 300.
3. Port Size: full port with no obstructions in the flow path when in the open position.

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4. Connection: Flanged.
5. Trim: Rising stem, trunion mounted, with external position indicator. Carbon steel core with Nickel-Boron overlay on core sealing surface. Bubble tight bidirectional shut off (zero leakage) to 300 psi differential. Double set of Teflon Chevron packing with packing injector. Top entry design, in-line repairable with friction free operation.
6. Seat Type: Single stationary seat with resilient insert suitable for 500 degrees F.
7. Warranty: Manufacturer's published 3 year warranty.

2.15 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Babbitt Steam Specialty Co.
 2. Roto Hammer Industries.
 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to ball, butterfly, and plug valve stems.
 3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.

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- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for valves NPS 4" and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. See drawings for valve types.
- B. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, high performance butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

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3. Throttling Service except Steam: Globe or ball or butterfly valves.
 4. Pump-Discharge Check Valves:
 - a. 2" and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. 2-1/2" and Larger: Center-guided, metal or resilient-seat check valves.
 5. Condenser water, hot water & reheat coils: As detailed on drawings.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- D. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, 2" and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, 2-1/2" to 4": Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, 5" and Larger: Flanged ends.
 4. For Steel Piping, 2" and Smaller: Threaded ends.
 5. For Steel Piping, 2-1/2" to 4": Flanged ends except where threaded valve-end option is indicated.
 6. For Steel Piping, 5" and Larger: Flanged ends.

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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.
- B. Vibration seismic and wind criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Noise criteria for this section is referenced in specification section 230548.1. Vendor/manufacturer/contractor is responsible for this section 230548.1 in its entirety.

1.2 SUMMARY

A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Fiberglass pipe hangers.
- 4. Metal framing systems.
- 5. Fiberglass strut systems.
- 6. Thermal-hanger shield inserts.
- 7. Fastener systems.
- 8. Pipe stands.
- 9. Equipment supports.

B. Related Sections:

- 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- 2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.

3. Division 23 Section "Vibration and Noise Controls for HVAC Piping and Equipment" for vibration isolation devices.
4. Division 23 Section "Ductwork" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 1. Trapeze pipe hangers.
 2. Metal framing systems.
 3. Fiberglass strut systems.
 4. Pipe stands.
 5. Equipment supports.

- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.
- D. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

- C. **Fiberglass Pipe-Hanger Installation:** Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. **Metal Framing System Installation:** Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. **Fiberglass Strut System Installation:** Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. **Thermal-Hanger Shield Installation:** Install in pipe hanger or shield for insulated piping.
- G. **Fastener System Installation:**
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. **Pipe Stand Installation:**
 - 1. **Pipe Stand Types except Curb-Mounted Type:** Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. **Curb-Mounted-Type Pipe Stands:** Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- J. **Equipment Support Installation:** Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 2" and larger and at

changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- P. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe 4" and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1".

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Clean and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal as specified in Division 09.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.

- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

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SECTION 230548

VIBRATION ISOLATION, SEISMIC, WIND & FLOOD
LOAD RESTRAINTS FOR HVAC, PLUMBING, ELECTRICAL,
& FIRE PROTECTION COMPONENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections apply to this Section.
- B. This section specifies required vibration control and seismic restraints for all equipment, where applicable, with the wind load requirements for all equipment in outdoor locations. Additionally, included are provisions for flood control as stated herein. When projects are located in a geographically active seismic, wind or flood location, Section 1.4, General Design and Performance Requirements, will elaborate on those requirements and include specifics pertaining to a facility's "continued operation." Para. 1.2, Section D is a partial list of components covered herein. This specification is part of the general conditions for the HVAC, Plumbing, Electrical and Fire Protection contracts.

1.2 SUMMARY

- A. This section includes the following:
 - 1. All equipment, piping, ductwork and conduit as noted on the drawing's schedule or in the specification shall be seismically braced if the building is so classified as listed herein. Vibration control shall apply as described in all cases herein.
 - 2. All outdoor equipment, including roof-mounted components, shall comply with section 1609, Wind Load, IBC-2006. There shall be no decrease of the effects of wind load on a component due to other structures or components acting as blocks or screens.
 - 3. All below, at grade or above grade locations located in a flood hazard area as defined and located herein.
 - 4. Seismic bracing, wind, flood load and isolation materials shall be the certified products of the same manufacturing group and shall be certified by that group.
 - 5. It is the intent of the seismic and wind load portion of this specification to keep all mechanical, electrical, plumbing and fire protection building system components in place during a seismic or high wind event and additionally operational where the occupancy category of the building so requires as listed herein.
 - 6. All such systems must be installed in strict accordance with seismic/wind codes, component manufacturer's and building construction standards.
 - 7. This specification is considered to be minimum requirements for seismic, wind, flood and vibration control considerations.

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8. Any variation, which results in non-compliance with the specification requirements, shall be corrected by the contractor in an approved manner.

B. The work in this section includes, but is not limited to, the following:

1. Vibration isolation for piping, ductwork, bus duct, cable tray conduit and equipment, all referred to as components.
2. Component isolation bases.
3. Seismic restraints for isolated components.
4. Seismic restraints for non-isolated components.
5. Wind restraints for isolated components.
6. Wind restraints for non-isolated components.
7. Flood restraints for isolated components.
8. Flood restraints for non-isolated components.
9. Certification of seismic, wind or flood restraint designs.
10. Installation supervision.
11. Design of attachment of housekeeping pads.
12. All components requiring IBC compliance and certification.
13. All inspection and test procedures for components requiring IBC compliance.

C. All mechanical, electrical, plumbing or fire protection equipment, pipe and ductwork, within, on or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.

D. Vibration isolation for all components crossing the building isolation joint.

E. Components referred to below are typical. (Components not listed are still included in this specification.) All systems that are part of the building in any way are referred to as components, including:

- AC Units
- Adapter Curb
- Air Handling Units
- Air Separators
- Battery Chargers
- Battery Racks
- Boilers
- Bus Ducts
- Cabinet Unit Heaters
- Cables
- Cable Trays
- Chillers
- Conduit
- Compressor
- Computer Room Units
- Condensing Units
- Cooling Towers
- Curbs
- Dry Coolers
- Ductwork
- Electrical Panels
- Equipment Supports
- Fans (all types)
- Fan Coil Units
- Fire-alarm Panels
- Gas Detection Systems
- Generators
- Heat Exchangers
- Humidifiers
- Light Fixtures
- Motor Control Centers
- Pipe
- Pumps (all types)
- Risers
- Rooftop Units
- Supports
- Switch Gear
- Tanks (all types)

- Transformers
- Unit Heaters
- Unit Substations
- Unit Ventilators
- Variable Frequency Drives
- VAV Boxes
- Vibration Isolators
- Water Heaters

1.3 DEFINITIONS (BUILDING AND COMPONENTS, ALL CODES)

A. Essential Facilities, (Occupancy Category, IBC-2006)

1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

B. Life Safety and High Hazard

1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire-alarm panels. (Life Safety)
2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment, including all lighting, generators, transfer switches and transformers. (Life Safety)
3. All medical and life support systems. (Life Safety)
4. Hospital heating systems and air-conditioning systems for maintaining normal ambient temperature. (Life Safety)
5. Automated supply, exhaust, fresh air, and relief air systems on emergency control sequence, including air handlers, duct, dampers, etc., or manually operated systems used for smoke evacuation, purge, or fresh air relief by the fire department. (Life Safety)
6. All gases or fluids that must be contained in a closed system which are flammable or combustible. Any gas that poses a health hazard if released into the environment and vented Fuel Cells. (High Hazard)
7. Heating systems in any facility in Seismic Use Group III, IBC-2000 or Occupancy Category IV, IBC-2003-2006 where the ambient temperature can fall below 32 degrees Fahrenheit. (Life Safety)

C. General

Anchor: A device, such as an expansion bolt, for connecting equipment bracing members to the structure of a building.

Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing analytical or inspection services, when such agency has been approved.

Attachment: See Positive Attachment below.

Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per Section 1609 (IBC-2006), or local code, if more severe. Local jurisdictions shall determine wind speeds for indicated special wind regions located near gorges or mountainous terrain. Section 6.5.4 of ASCE 7-05 shall be used after determination of basic wind speed by the local

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jurisdiction. See Section 1609.3 ASCE 7-05 for basic wind speed determination in non-hurricane prone regions.

Bracing: Metal channels, cables or hanger angles that prevent components from breaking away from the structure during an earthquake or high winds. See also Longitudinal Bracing and Transverse Bracing. Together, they resist environmental loads from any direction.

Certificate of Compliance: A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents, provided by an approved agency. (Certificate to be supplied by equipment component manufacturer.)

Component: A non-structural part or element of an architectural, electrical, mechanical, plumbing or fire protection system within or without of a building system.

Component Importance Factor: Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5.

Component, Flexible: Component, including its attachments, having a fundamental period greater than 0.06 seconds.

Component, Rigid: Component, including its attachments, having a fundamental period less than or equal to 0.06 seconds.

Consequential Damage: The functional and physical interrelationship of components, their supports and their effect on each other shall be considered so that the failure of an essential or non-essential architectural, mechanical or electrical component shall not cause the failure of an essential architectural, mechanical or electrical component.

Equipment: Systems associated with ducts, pipes, and conduits also called components.

Flood or Flooding: A general and temporary condition or partial and complete inundation of normally dryland from:

1. The overflow of inland or tidal waters.
2. The unusual and rapid accumulation of runoff of surface waters from any source.

Flood Hazard Area: The greater of the following of two areas:

1. The area within a flood plain subject to a 1 percent or greater chance of flooding in any year.
2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

Special Flood Hazard Area Subject to High Velocity Wave Action: Area within the flood hazard area that is subject to high velocity wave action and shown on a Flood Insurance Rate Map (FIRM) or another flood hazard map as zone V, VO, VE or VI-30.

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Flood Insurance Rate Map (FIRM): An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

Gas Pipes: For the purposes of this Specification Guide, gas pipe is any pipe that carries fuel, gas, fuel oil, medical gas, or compressed air.

Hazardous Contents: A material that is highly toxic or potentially explosive or corrosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.

Hurricane Prone Regions: Areas prone to hurricanes include the U.S. Atlantic Ocean, Gulf Coasts, Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa where the wind speed is greater than 90 mph.

Importance Factor, I: A factor that accounts for the degree of hazard to human life and damage to property.

Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency (see Section 1703.5 and "Label" and "Manufacturer's Designation" and "Mark").

Isolation Joint: The theoretical line separating isolated and non-isolated parts of the structure.

Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency (see Section 1703.5 and "Inspection Certificate," "Manufacturer's Designation" and "Mark").

Lateral Forces: A force acting on a component in the horizontal plane. This force can be in any direction.

Longitudinal Bracing: Bracing that prevents a component from moving in the direction of its run.

Longitudinal Force: An applied force that happens to be in the same direction as the duct or pipe run.

Mark: An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (see also "Inspection Certificate," "Label," and "Manufacturer's Designation").

Manufacturer's Designation: An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules (see also "Inspection Certificate," "Label," and "Mark").

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Occupancy Category: A classification used to determine structural load requirements including those imposed by wind, flood, snow, and seismic based on occupancy of the structure.

Positive Attachment: A mechanical device, designed to resist seismic forces, which connects a non-structural element, such as a duct, to a structural element, such as a beam. Bolts and welding are examples of positive attachments. Surface glue and friction anchorage do not constitute positive attachment. Examples of positive attachment are epoxy cast in anchors and drill in wedge shaped anchor bolts to concrete and welded or bolted connections directly to the building structure. Double-sided beam clamps, C Type are not acceptable as either brace point attachments to the structure or for the support of the component at the bracing location.

Seismic: Related to an earthquake. Seismic loads on a structure are caused by wave movements in the earth during an earthquake.

Seismic Design Category: A classification assigned to a structure based on its Seismic Use Group or Occupancy Category and the severity of the design earthquake ground motion at the site.

Seismic Forces: The assumed forces prescribed herein, related to the response of the structure to earthquake motions, to be used in the design of the structure and its components.

Seismic Use Group, Occupancy Category, IBC-2006: A classification assigned to a building based on its use as defined in Section 1604.516.2.

Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in Table 1613.5.2 (IBC-2006).

Special Inspection: Inspection as herein required of the materials, installation, fabrication, erection or placement of components and connections requiring special documents and referenced standards (see Section 1704, IBC-2006).

Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

Story Drift Ratio: The story drift (lateral displacement) divided by the story height.

Transverse Bracing: Bracing that prevents a component from moving from side to side.

Wind-Borne Debris Region: Portions of hurricane-prone regions that are within 1 mile of the coastal mean high water line where the basic wind speed is 110 mph or greater, or portions of hurricane-prone regions where the basic wind speed is 120 mph or greater; or Hawaii.

1.4 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

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A. General Design Requirements

1. SEISMIC CONSIDERATIONS: This project has seismic design requirements as follows:
 - a. Occupancy Category II (Seismic Design Category C)
Life Safety Components ($I_p = 1.5$)
High Hazard Components (All Gas Fired Components; Indoor and Outdoor) ($I_p = 1.5$)
Components affected by Consequential Damage ($I_p = 1.0$)
2. WIND CONSIDERATIONS: This project has wind design requirements as follows:
 - a. Wind load in hurricane, tornado and/or wind-borne debris regions (90 plus mph) having a building height greater than 60 feet. Rooftop structures; Section 6.5.15.1 of ASCE 7-05 design requirements apply.
3. FLOOD CONSIDERATIONS: This project has design requirements in accordance with FEMA and/or FIRM as follows:
 - a. None.
4. BUILDING ISOLATION CONSIDERATIONS: This project has isolation bearings, which isolate the building from ground-borne vibration. Components which cross the isolation joint formed by these bearings must include vibration isolation per the requirements of this specification.

B. General Design Performance Requirements

1. Seismic and Wind Load Certification and Analysis:
 - a. Attachment calculations by the Seismic Restraint Manufacturer's licensed Engineer substantiating the mounting system, seismic or wind restraints, fasteners or ICC Certified Concrete Anchors shall be submitted for approval along with the shop drawings. Seismic loads shall have their calculations based on seismic loads as established in Specification Section 1.4, Paragraph B, Article 7, Design Seismic Loads. Wind loads shall have their calculations based on Section 1.4, Paragraph B, Article 8, Design Wind Loads. A registered professional engineer having a PE from the same state as the project, or state of restraint manufacturer shall stamp all analysis, or as required by local building codes.
 - b. Unless otherwise specified, all equipment, piping and ductwork shall be restrained to resist seismic forces. Restraints shall maintain equipment, piping or ductwork in a captive position. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest issue of:
 - 1) International Building Code, IBC and ASCE applicable state and local codes
 - 2) NFPA (Fire Protection only)
2. Importance Factor, $I_p = 1.5$ Components:

Commented [Lindner1]: Should that be 7 not 5?YES

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- a. In addition to all of the above provisions, for components having an I_p greater than 1.0, all trades shall comply with Sections 16 and 17 of the International Building Code using, when available, vendors that comply with the provisions stated herein and submitting the special inspections listed within these specifications. Where compliance is not possible, each contractor shall submit a vendor report (Form CVC-1 at end of this specification) clearly indicating that none of the specified, listed or other vendors known to the contractor meets the compliance, testing and certification portions of the IBC specification's Sections 16 and 17. Special inspections of the component installation shall still be conducted (Section 1.4, Paragraph B, Article 4) even if no vendors meet the following requirements. All non-isolated and isolated equipment (components) shall be secured to the structure in accordance with that code.
3. All component manufacturers shall submit for approval the following as required below:
- a. For all life safety system components noted in this specification: the Approved Agency's Certificate of Compliance for the specific equipment on this project when the Seismic Design Category is C through F. Analytical or Shaker Test certification through the component's load path to structure at its center of gravity shall include anchorage, structural and on-line capability. Use of seismic experience data shall be permitted if evidence confirms that the historical based component has the same construction and weight and accompanying center of gravity as submitted unit and basis of experience claim conforms to loads derived in testing with accompanying accelerations based on AC-156. Seismic qualification by seismic experience data based upon nationally recognized procedures acceptable to the authority having jurisdiction shall be deemed to satisfy the design and evaluation requirements provided that the substantiated seismic capacities equal or exceed the seismic demands determined in accordance with Sections 13.3.1 and 13.3.2 of ASCE 7-05.
 - b. In addition, all components needed for the continued operation of the facility in the above stated categories will have the manufacturer of that component submit the Approved Agency's Certificate of Compliance for their equipment when the Seismic Design Category is C through F. Analytical or Shaker Test certification through the component's load path to structure at its center of gravity shall include on line capability. This requirement also pertains to projects that combine an emergency preparedness center within a structure of another Use Group. Where components do not affect the facility's functional operation but could affect the performance of other components should they dislodge, only anchorage of that component requires compliance. Components needed for continued operation of the building require Analytical or Shaker Test certification through the total component's load path to structure calculated at its center of gravity. Certification shall prove anchorage, structural and online capability. For use of seismic experience data, see (a) above.
 - c. All components containing hazardous or flammable materials will have the manufacturer of the component submit the Approved Agency's Certificate of Compliance for their equipment when used on any project having a minimum Seismic Design Category of C through F. Testing shall be conducted by Analytical or Shaker Test through the total component's load path to structure at its center of gravity and shall prove anchorage, structural capability and hazardous material containment. Testing shall prove that no internal component will rupture to insure

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against loss of hazardous or flammable (explosive) material that could support combustion, ignite or contaminate.

- d. All components requiring anchorage compliance only, not listed in the above categories, shall have the manufacturer of each component submit a PE stamped calculation package stating that their project specific equipment will accept anchorage by calculating its reactions through the component's load path to structure at its center of gravity at the designated anchorage locations. This requirement is for all projects having a Seismic Design Category of C through F.

4. Special and Periodic Inspection: (Occupancy Category IV Projects)

The following systems shall require Special Inspection and Periodic Special Inspection for seismic installation and anchorage during the course of construction, as defined earlier in this section for all buildings in Seismic Design Categories C through F.

- a. All smoke control systems. Periodic Special Inspection during erection of ductwork and prior to concealment, for leakage testing. Additionally, prior to occupancy for pressure differential testing. (see IBC-2000, Section 1704.14)
- b. All electrical components for standby or emergency power systems require Periodic Special Inspection.*
- c. All electrical equipment in Seismic Design Categories E and F. (Periodic)*
- d. All flammable, combustibile and highly toxic piping and their associated mechanical systems. (Periodic)*
- e. All ductwork containing hazardous materials. (Periodic)*
- f. All equipment using combustibile or toxic energy sources. (Special -1)
- g. All electric motors, transformers, switchgear unit substations and motor control centers. (Special -1)
- h. Reciprocating and rotating type machinery. (Special -1)
- i. Pipe, 3" and larger. (Special -1)
- j. Tanks, heat exchangers and pressure vessels. (Special -1)
- k. Isolator units for seismic isolation system. (Periodic)*
- l. Manufacturer's written Quality Control Program for projects in Seismic Design Categories E or F

5. Contractor Responsibilities and Approvals: (Occupancy Category IV Projects)

- a. Each contractor responsible for the installation of the components asterisked above (*) shall be responsible for submitting a written contractor's Statement of Responsibility (IBC Section 1706.1) (as outlined below) to the design team for their approval.
- b. In addition, all -1 items above require Special Inspection in accordance with IBC Section 1707.8 (Form CQAP and SQA-1) at the end of this specification.
- c. Contractor shall:
 - 1) Identify the components that are part of the Quality Assurance Plan. (Asterisked above)*
 - 2) Identify all Special Inspection and Testing for components installed as part of this contract.

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- 3) List control procedures within the contractor's organization for all special inspection and testing, including methods, frequency of reporting and their distribution of those reports.
 - 4) List all personnel, including their qualifications, exercising control over the seismic aspects of the project.
6. Seismic Use Group I & II, IBC-2000 & Occupancy Category II & III Structures, IBC-2003-2006, Ip 1.0, Seismic Design Category C:
 - a. Projects in these categories require seismic bracing for all life safety and high hazard components, Paragraph 1.3B sub-paragraphs 1, 2, 5 and 6. In addition, any un-braced component that could adversely affect the performance of a component that must remain functional, Ip 1.5, or could cause the failure or release of hazardous materials (gas or liquid fuel), must be braced or anchored to avoid such failure. This includes any component that could fall or move laterally. (Consequential Damage, ASCE 7-05, Section 16.2.3.)
7. Design Seismic Loads:
 - a. Projects in the United States have a minimum design load of 0.4g for statically mounted components and 0.5g for resiliently mounted components. Actual loads for both internal and external isolation and/or anchorage of components shall be as above or as calculated for the specific project location but in no event shall it be less than the above.
 - b. Exclusions for seismic restraint of piping and duct shall be according to applicable codes and as stated herein. The minimum horizontal restraint capability shall be 0.4g horizontal and 0.27g vertical (in addition to the gravity load). Life safety equipment defined above shall be designed to withstand a horizontal load of 0.9g and a vertical load of 0.6g.
 - c. Analysis for anchorage must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment depth and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in this section, acting through the equipment center of gravity.
 - d. Vertical load shall be calculated at 1/3 the horizontal load as a minimum, or, as prescribed by the code as 0.2 times Sds.
 - e. Internally isolated equipment in lieu of specified isolation and restraint systems must meet all of the requirements of this section, all articles.
 - f. A Seismic Design Errors and Omissions Insurance Certificate MUST accompany the seismic restraint equipment manufacturer's calculation. Product liability insurance certificates are not acceptable.
 - g. Whether the equipment is internally or externally isolated and restrained, the entire unit assembly must be seismically attached to the structure. Curb or roof rail mounted equipment must not only have seismic or wind attachment of the equipment to the roof but also to the curb or rails. The attachment and certification thereof shall be by this section. Sheet metal screw attachment is acceptable provided that the following five conditions are met and verified.

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- 1) Calculations support sufficient quantity and size of sheet metal screws to handle all loads including shear.
 - 2) Shear and tension allowables are obtained from an accredited third-party source, such as ICC or NDS, not from the screw manufacturer.
 - 3) Space or gap between the inside overhang of the rooftop unit and the curb at each of the screw locations is closed with structural material, tapered to contour to both the curb and the components' inside edge structure.
 - 4) Attachment points of the roof-mounted unit to curb and the curb to structure demonstrates structural load path.
 - 5) The method of attachment does not violate the NRCA rating of the curb by violating the roof member's waterproofing.
- h. Failure is defined as the discontinuance of any attachment point or load path between component and structure. Permanent deformation of the component is acceptable as long as the component continues to operate without failure and, if permanent, it is within acceptable manufacturing or structural tolerances.
8. Design Wind Loads:
- a. All outdoor mounted components shall be positively fastened to their supporting structure as discussed below. Fastening to metal deck is unacceptable.
 - 1) If component is curb mounted, Article 7, Design Seismic Loads, Paragraph g shall be followed for all roof-mounted components in excess of 9 sq. ft. in cross-sectional area. Curbs shall be as described in Base Type B-3 if isolated, Base Type B-4 if non-isolated.
 - 2) If component is support mounted, Article 7, Design Seismic Loads, Paragraph g shall be followed for all roof-mounted components requiring waterproofed rail supports. Equipment supports shall be Base Type B-5 if isolated, Base Type B-6 if non-isolated.
 - 3) If equipment is dunnage mounted, positive attachment shall occur through welding or bolting of equipment to dunnage steel.
 - b. Loads and calculations shall be based on IBC-2006, Figure 1609 and related sections in ASCE 7-05.
 - c. Where buildings are less than or equal to 60 feet in height to the top of the roof slab (not parapet walls), the force on roof-mounted components shall be based on Section 6.5.15.1, ASCE 7-05.
 - d. Equivalent basic wind speed shall be based on IBC-2006, Table 1609.3.1.
 - e. In no event shall adjacent buildings, structures or screens be considered to diminish the calculated wind load or its effect on an outdoor component.
9. Design Flood Loads:
- a. When a building or structure is located in a flood hazard area, anchorage for all components subjected to those locations shall follow Section 1.4 B 3d for their proper fastening to structure.

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- b. Components used for anchorage purposes shall be hot dipped galvanized, cadmium-plated or powder-coated for the purpose of anti-corrosion.
10. Additional Seismic Design Requirements for Fire Protection Components
- a. Fire sprinkler piping system shall be braced to meet the minimum requirements of NFPA No. 13. Additionally, all branch lines will be braced for structures in Occupancy Category IV, IBC-2003-2006.
 - b. All branch lines shall be end tied if not braced (Occupancy Categories II & III).
 - c. Standpipe risers shall be provided with a minimum of (1) flexible coupling (Victaulic Style 77 or equal) to accommodate lateral drift at each floor level.
 - d. Vertical pipe risers shall have their weight, where possible, supported above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser and at intermediate points not to exceed 30'.
 - e. Friction connections of any fire protection line to structure are not permissible under any circumstances. All connections must be positive.
 - f. Branch lines shall never act as a brace to mains or cross-mains.
 - g. All pipe sleeves through floors shall be designed to accommodate differential movement between the floors.
 - h. All pipe sleeves through walls shall be designed to accommodate differential movement between the structures, when the walls are separations between two independently moving structures.
11. Requirements for components crossing the building isolation joint, as shown in WSP structural drawings.
- a. "Crossing the building isolation joint" refers to any component which is supported from both:
 - 1) Un-isolated structure: including but not limited to slabs, columns, partitions, core walls, etc., BELOW the first-floor slab AND:
 - 2) Isolated structure: including but not limited to, slabs, columns, partitions, core walls, etc., ABOVE AND INCLUDING the first-floor slab.
 - b. Components which cross the building isolation joint shall be resiliently supported from the un-isolated structure, as described in this specification.
 - c. The resilient support shall have a maximum natural frequency of 8 Hz when subject to operational load (including weight of component, secondary supported components such as piping, and additional operational weight such as fuel, water, oil, etc.).
 - d. Penetrations through the first-floor slab shall be resiliently disconnected from the slab. This requires oversizing the penetration and back-filling with a permanently resilient joint filler material as described in following sections.

1.5 SUBMITTALS

- A. Refer to Part 1, General.

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- B. Product Data: The manufacturer of vibration isolation, seismic, wind and flood restraints shall provide submittals for products as follows:
1. Descriptive Data:
 - a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
 - b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and restraints by referencing numbered descriptive drawings.
 2. Shop Drawings:
 - a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
 - b. Provide all details of suspension and support for ceiling hung equipment.
 - c. Where walls, floors, slabs or supplementary steel work are used for restraint locations, details of acceptable attachment methods for ducts and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturer's submittals must include spacing and maximum seismic/wind loads at the restraint points.
 - d. Provide specific details of restraints and anchors, include number, size and locations for each piece of equipment. Restraint and anchor allowables shall be by structural testing, shake testing, analysis or third-party certification.
 - e. Calculations shall be submitted as required in Section 1.4, General Design and Performance Requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer of vibration isolation, seismic and wind load control equipment or manufacturer's approved representative shall have the following responsibilities:
1. Determine vibration isolation and restraint sizes and locations.
 2. Provide vibration isolation and restraints as scheduled or specified.
 3. Provide calculations and materials, if required, for restraint of non-isolated equipment.
 4. Provide installation instructions in writing, drawings, and trained field supervision, where necessary, to insure proper installation and performance.
 5. Certify correctness of installation upon completion, in writing.
 6. All provisions of Section 1.4, General Design and Performance Requirements.
- B. All manufacturers of vibration control, seismic, wind or flood restraining systems must provide a Seismic Design Error and Omissions Insurance Certificate for their firm or their design consultant to certify their ability to provide engineering and design as required by this section. This document shall be provided at the time of first submittal from the seismic restraint provider.
- C. All manufacturers of any type of equipment including OEM are responsible for Section 1.4.

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- D. Equipment manufacturer's substitution of internally or externally isolated and/or restrained equipment supplied by the equipment vendor, in lieu of the isolation and restraints specified in this section, is acceptable provided all conditions of this section are met. The equipment manufacturer shall provide a letter of guarantee from their engineering department, PE stamped and certified per the section on the Seismic Restraint Design (See Section 1.4B, Article 3), stating that the seismic restraints are in full compliance with these specifications. Where used on an Essential or High Hazard Facility, manufacturer's certification proving online capability shall be required in addition to all requirements stated in Section 1.4B. Letters from field offices or representatives are unacceptable.
- E. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the component vendor in the event of non-compliance with the preceding. Substitution of internal isolation is unacceptable for:
 - 1. Indoor or outdoor mounted equipment over or adjacent to:
 - a. Patient or operating areas
 - b. Theatre space
 - c. Office locations
 - d. Assembly areas

1.7 RELATED WORK

- A. Housekeeping pad structural design, including its attachment to building structure, shall be by the structural engineer of record or as shown on the contract drawings. Attachment of all components and restraints to the pad and size of the pad shall be designed and certified according to this section by the seismic/isolation supplier. Material and labor required for attachment and construction shall be by the concrete section contractor, or by the contractor where specified. Housekeeping pads shall be sized to accommodate a minimum 6" of clearance all around the equipment; or 12 times the outermost anchor bolt diameter, whichever is greater. Where exterior isolators are used, this distance shall be as measured from the outermost holes in the isolator base plate to the edge of the housekeeping pad.
- B. The project's structural engineer shall design all roof and interior steel to support and make connections to all components, including roof-mounted equipment specified in other sections. Design shall comply with IBC requirements including load path to structure.
- C. Roof steel supporting roof-mounted equipment shall be designed for all seismic and wind forces including, but not limited to, tension, compression and moment loads.
- D. Chimneys, stacks and boiler breeching passing through floors are to be attached at each floor level with a riser guide.
- E. Where ceilings are not braced, lay-in lighting fixtures, weighing more than 20 lbs, shall have at least 2 independent corner diagonal wire ties to structure.

- F. Lay-in ceilings in compliance with seismic code requirements may use earthquake clips or other approved means of positive attachment to brace fixtures such as panel lights and diffusers less than 40 lbs to T-bar structures. Local codes dictate fixture support requirements.

1.8 CODE AND STANDARDS REQUIREMENTS

A. Typical Applicable Codes and Standards

1. All City, State, and Local Codes (Code)

- a. SMACNA Guidelines for Seismic Restraint of Mechanical Systems, Second Edition (Standard reference, to be used for design purposes only, not code)
- b. NFPA 13 and 14 for Fire Protection System (Standard)
- c. American Society for Testing and Materials (ASTM) (Standard)
- d. International Conference of Building Officials (ICBO) (Standard)
- e. International Building Code (Code)
- f. ASHRAE (Standard reference, to be used for design purposes only, not code)
- g. VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association) (Standard reference, to be used for design purposes only, not code)

- B. In cases where requirements vary, the guideline for the most stringent shall be utilized.

- C. International Fire Code

- D. Use IBC-2006 as reference code standard unless otherwise designated.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. All vibration isolators and seismic restraints described in this Section shall be the product of a single manufacturer. The basis of this specification is Mason Industries contact, Doug Valerio, at 631-348-0282 and dvalerio@mason-ind.com. Products from other nationally recognized manufacturers are acceptable provided their systems strictly comply with these specifications and have the approval of the specifying engineer. Manufacturer shall be a regular member of VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association).

2.2 VIBRATION ISOLATION TYPES

- A. Type A: Spring Isolator - Free Standing
MASON INDUSTRIES SLF

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1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded elastomeric cup or ¼" elastomeric acoustical friction pad between the bottom of isolator and the support.
 2. All mountings shall have leveling bolts that must be rigidly bolted to the equipment.
 3. Spring diameters shall be no less than 0.8" of the compressed height of the spring at rated load.
 4. Springs shall have a minimum additional travel to solid equal to 50% of the operating deflection.
- B. Type B: Seismically and Wind Restrained Spring Isolator
MASON - SLR, SLRS, SLRSO, SSLFH
1. Restrained spring mountings shall have a Type A spring isolator within a rigid housing that includes vertical limit stops to prevent spring extension if weight is removed. The housing shall serve as blocking during erection. A maximum clearance of ¼" shall be maintained around restraining bolts and internal elastomeric deceleration bushings. Limit stops shall be out of contact during normal operation. If housings are to be bolted or welded in position, there must be an internal isolation pad or elastomeric cup. Housing shall be designed to resist all seismic forces.
- C. Type C: Combination Spring/Elastomer Hanger Isolator (30° Type)
MASON - 30N
1. Hangers shall consist of rigid steel frames containing minimum 1-¼" thick elastomeric elements at the top and a steel spring with general characteristics as in Type A. The elastomeric element shall have resilient bushings projecting through the steel box.
 2. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the rod bushing and short-circuiting the spring.
 3. Submittals shall include a hanger drawing showing the 30° capability.
 4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.
- D. Type D: Elastomer Double Deflection Hanger Isolator
MASON - HD
1. Molded (minimum 1-¼" thick) elastomeric element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be a minimum of 0.35".
 2. Steel retainer box encasing elastomeric mounting capable of supporting equipment up to two times the rated capacity of the element.
- E. Type E: Combination Spring/Elastomer Hanger Isolator
MASON - DNHS
1. Spring and elastomeric elements in a steel retainer box with the features as described for Type C and D isolators.
 2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.

Commented [Lindner6]: Add "?? YES

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3. 30° angularity feature is not required.
- F. Type F: Seismically Restrained Elastomer Floor Isolator
MASON - BR, RBA, RCA, RDA
1. Bridge-bearing elastomeric mountings shall have a minimum static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron or aluminum casting containing molded elastomeric elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock-absorbing elastomeric materials shall be compounded to bridge-bearing or Durulene™ specifications.
- G. Type G: Pad Type Elastomer Isolator (Standard)
MASON - SUPER W
1. One layer of ¼" thick elastomeric pad consisting of 2" square modules for size required.
 2. Load distribution plates shall be used as required.
 3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.
- H. Type H: Pad Type Elastomer Isolator (High Density)
MASON - HL
1. Laminated canvas duck and neoprene, maximum loading 1000 psi, minimum ½" thick.
 2. Load distribution plate shall be used as required.
 3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.
- I. Type I: Thrust Restraints
MASON - WBI or WBD
1. A spring element similar to Type A isolator shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to ¼" due to thrust forces. Contractor shall supply hardware.
 2. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.
- J. Type J: Pipe Anchors
MASON - ADA
1. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing or piping separated by a minimum ½" thick 60 durometer elastomer.
 2. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction.
 3. Applied loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.

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K. Type K: Pipe Guides
MASON - VSG

1. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing or piping separated by a minimum $\frac{1}{2}$ " thickness of 60 durometer elastomer.
2. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and replaceable to allow for selection of pipe movement.
3. Guides shall be capable of $\pm 1\text{-}5/8$ " motion, or to meet location requirements.

Commented [Lindner8]: 60 what? durometer

L. Type M: Lateral Isolator
Mason Industries Type BR

1. Components drawing their support laterally shall be resiliently supported by a neoprene lateral isolator.
2. Isolator shall comprise a ductile iron casting containing two separated and opposing molded neoprene elements. These elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation.

M. Type N: Resilient Sway Brace
Mason Industries Type AB-716

1. Components which require sway bracing shall incorporate a resilient sway brace comprised of angle iron sections with provision for bolting to the structure and a minimum thickness of $3/8$ " sponge cemented to the vertical leg.
2. The sponge cemented to the vertical leg shall be a $3/8$ " thick resilient PVC sponge.

2.3 SEISMIC RESTRAINT TYPES

A. Type I: Spring Isolator, Restrained
MASON SL, SLRSO, SLRS, SSLFH

1. Refer to vibration isolation, Type B.

B. Type II: Seismically Restrained Elastomer Floor Isolator
MASON - BR

1. Refer to vibration isolation Type F.

C. Type III: All-Directional Seismic Snubber
MASON - Z1011

1. All-directional seismic snubbers shall consist of interlocking steel members restrained by an elastomeric bushing. Bushing shall be replaceable and a minimum of $1/4$ " thick. Applied loading shall not exceed 1000 psi. A minimum air gap of $1/8$ " shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances.

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Elastomeric bushings shall be rotated to insure no short circuits exist before systems are activated.

D. Type IV: Floor or Roof Anchorage
Cast-In-Plates

1. Rigid attachment to structure utilizing wedge type anchor bolts, anchored plates, machine screw, bolting or welding. Power shots are unacceptable.

E. Type V: Seismic Cable Restraints
MASON - SCB/H0, H1, H2, H3, H4

1. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges.

F. Type VI: Rigid Arm Brace
MASON - SSBS

1. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Seismic solid brace end connects shall be steel assemblies that swivel to the final installation angle and utilize two anchor bolts to provide proper attachment spaced to ICBO standards for attachment to concrete.

2.4 EQUIPMENT BASES

A. General

1. All curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck (minimum thickness shall be 4") for resisting wind and seismic forces in accordance with the project location. (Fastening to metal deck is unacceptable.)

B. Base Types

1. Type B-1: Integral Structural Steel Base
MASON - MSL or WFSL
 - a. Rectangular bases are preferred for all equipment.
 - b. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case and end suction pumps shall include supports for suction and discharge elbows.
 - c. All perimeter members shall be structural steel beams with a minimum depth equal to 1/12 of the longest dimension between isolators.

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- d. Base depth need not exceed 12" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
 - e. Height saving brackets shall be employed in all mounting locations to provide a minimum base clearance of 2".
2. Type B-2: Concrete Inertia Base
MASON - BMK or KSL
- a. Vibration isolation manufacturer shall furnish rectangular welded or bolted modular steel concrete pouring forms for floating and inertia foundations.
 - b. Bases for split case and end suction pumps shall be large enough to provide for suction and discharge elbows.
 - c. Bases shall be a minimum of 1/12 of the longest dimension between isolators but not less than 6".
 - d. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.
 - e. Forms shall include a minimum concrete reinforcing consisting of 3/8" bars welded in place a maximum of 16" on centers running both ways in a layer 1 to 1 1/4" above the bottom.
 - f. Forms shall be furnished with steel templates to hold the component anchor bolts sleeves and anchors while concrete is being poured.
 - g. Height saving brackets shall be employed in all mounting locations to maintain a 2" minimum operational clearance below the base.
3. Type B-3: Seismic Isolation Curb
MASON - RSC
- Option: Sound Package 1 & 2 Mason Db
- a. Curb-mounted rooftop equipment shown on isolation schedule shall be mounted on structural seismic spring isolation curbs. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. The lower frame must accept point support for both seismic attachment and leveling. The upper frame must be designed with positive fastening provisions (welding or bolting), to anchor the rooftop unit to the curb, which will not violate the National Roofing Contractors Association (NRCA) ratings of the membrane waterproofing. Sheet metal screws are only acceptable if all provisions in Section 1.4, Article B, Paragraph 7, Design Seismic Loads, are met. Contact points between the rooftop unit, the curb and the building's structure shall show load path through those locations only.
 - b. All-directional elastomeric snubber bushings shall be minimum of 1/4" thick. Steel springs shall be laterally stable and rest on 1/4" thick elastomeric acoustical pads or cups.
 - c. Hardware must be plated and the springs shall be powder-coated or cadmium-plated. The curb's waterproofing shall be designed to meet all NRCA requirements.
 - d. All spring locations shall have full spring view access ports with removable waterproof covers and all isolators shall be adjustable, removable and interchangeable.

Commented [Lindner9]: Is this the correct reference? No Article B, para 7, Design Seismic Loads

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- f. Isolated curbs shall be supplied with a continuous air seal between the upper floating member and the stationary wood nailer.

Option #1 Where sound barrier package is required, curb shall have full size lay in attenuation panels having a minimum STC rating of 60 when combined with the roof deck's rating. Attenuation system shall add a full sound attenuation structural floor to the curb capable of spanning the curb's width and designed for live loads of 20 psf. Panels shall not weigh more than 6 psf. The 4" nominal galvanized panel shall be joined to allow for airtight construction and additionally shall have a support system where the panels are used below an outside condenser section. Panels shall be waterproof for both outdoor and indoor application. The space below the curb panels and the roof deck shall have 4" of insulation contractor furnished and installed.

Curb wall construction shall utilize the roofer's standard insulation where curbs use the TAS open thermal acoustical screening system. Solid wall curbs shall use 2" of the factory duct liner installed by the curb manufacturer. The entire curb shall have a continuous neoprene elastomeric air seal.

Option # 2 When Curb Type SRPFMA (Supply Return Plenum Construction) is required, in addition to Option # 1 the walls of the supply section will use 2" sound attenuating panels as well as a continuous inner elastomeric air seal and isolated plenum divider. Both supply and return ducts shall seal directly to curb base floor attenuation panels.

4. Type B-4: Seismic Non-Isolated Curbs
MASON - RRC

Option: Sound Package Mason Db

- a. Seismic curbs shall have all provisions as Type B-3 curbs with the exception of spring isolation.
- b. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.

5. Type 5: Isolated Equipment Supports
MASON - RSR

- a. Continuous structural equipment support rails that combine equipment support and isolation mounting into one unitized roof flashed assembly with all features as described for Type B-3.
- b. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.

6. Type B-6: Non-Isolated Equipment Supports
MASON - RRR

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- a. This shall have the same provisions as Type B-5 without the spring isolation.
7. Type B-7: Computer Room Unit Base
MASON SEISMIC FLOOR STAND
 - a. Computer Room air-conditioning units shall be welded or bolted to welded structural steel stands having a minimum 0.5 "G" certified lateral acceleration capabilities, but no less than the design seismic loads.
 - b. Elastomeric isolated stands shall have 1" of adjustment to accommodate floor irregularities and 0.25" of nominal static deflection.
 - c. Spring isolated stands shall have 1" of adjustment to accommodate floor irregularities and 2" of nominal static deflection.
 - d. Bolting or welding is required to meet seismic criteria.
 - e. Stands to have positive fastening provisions for bolting of computer room unit to seismic floor stand and fastening of seismic isolated floor stand to structure, capable of carrying the design seismic loads.
 8. Type B-8: AHU / AC Unit Structural Base Frames
 - a. Where roof mounted Air-conditioning or Air Handling Units are placed on steel platforms and are incapable of being point loaded or supported, structural frames shall be furnished which will either match the centerline dimensions of the unit's base frame rail or its curb dimensions. The structural frame shall have provisions to be welded or bolted to the unit's base frame and shall be supported on Type "B" wind /seismic restrained isolation system.
 - b. Isolator deflection shall be either 1.5" or 2.5" depending on the tonnage of the roof mounted component as shown in Isolation Table "A". Structural Base Frame shall be type WFSL as manufactured by Mason.

2.5 FLEXIBLE CONNECTIONS

- A. Flexible Connections for HVAC AC Units, Cooling Tower Fire Pump, S&D, Fuel Oil, Water, Gas Manifold, and Generator
 1. Flexible stainless-steel hoses with a safety factor of 4 shall be manufactured using type 304 stainless steel braid and hose with one raised face fixed and one floating steel plate flange. Sizes 2-1/2" (65-mm) and smaller may have threaded male nipples. Hoses 4" (100-mm) or smaller, with copper sweat ends, may have stainless steel (gas service) or bronze (water service) bodies. Grooved ends may be used in sizes 2" (50-mm) through 12" (300-mm). Welding is not acceptable. To assure flexibility, minimum live lengths and minimum number of convolutions per foot are as tabulated. Shorter lengths are not acceptable.
 2. Forces required to displace connections under operating pressure shall not exceed the values tabulated as proven by testing under supervision by an independent PE.
 3. Hoses shall be installed on the equipment side of the shut off valves horizontal and parallel to equipment shafts wherever possible.

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4. Submittals shall include original test data showing force/displacement, fittings, material, live lengths, number of corrugations per foot and safety factor at pressure ratings. Hoses shall be type FFL, MN, GN, CPS or CPSB as manufactured by Mason Industries, Inc.

B. Flexible Connections (for Fire/Sprinkler Riser at Isolation Joint/Plane) (Flexible Loops)

1. Flexible loops shall consist of two braided stainless hoses joined by a 60° V fitting at the base and 120° return elbows. Loops shall be capable of plus or minus 4" seismic motion in all planes, or acceptance of 6" axial piping expansion.

Flexible loops in steel lines shall have 304 stainless hose and braid. Copper lines, bronze hose and braid. All flanged connections shall have free floating flanges at each end to allow for the misalignment of piping flange holes and 360° rotation into optimum available space.

TABLE 2.2A FORCE REQUIRED for 6" AXIAL INWARD MOVEMENT BASED ON TESTS

psi	FORCE (lbs) FOR STAINLESS VEE SIZES													
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
50	4	4	5	8	9	22	60	75	90	230	350	1200	1900	1900
100	5	4	6	12	13	28	90	120	140	240	520	1650	2700	2800
150	5	5	7	17	18	38	125	160	200	370	660	2200	3300	3400
170	5	5	7	18	19	40	130	170	215	380	680	2350	3700	3750
180	5	6	8	20	20	42	140	180	235	390	720	2500	-	-
200	5	6	9	21	22	44	160	200	290	400	850	-	-	-
230	5	7	10	23	24	50	180	230	290	-	-	-	-	-
250	5	7	10	26	27	54	190	280	-	-	-	-	-	-

psi	FORCE (lbs) FOR COPPER VEE SIZES								
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
50	4	6	7	13	13	25	80	90	140
100	5	7	8	18	24	40	120	150	230
150	5	8	9	20	25	45	150	200	300
175	5	9	12	25	38	63	170	230	350

Forces required to move the loops shall not exceed the Mason tested values shown in Table 2.2A. Loops shall have a minimum burst pressure of four times their rated pressure at 70°F.

Flexible loops may be furnished with steel threaded nipples, weld ends, grooved ends, copper sweat ends, or raised face floating carbon steel flanges on both ends, as required. Fixed flanges are not acceptable.

Flexible loops shall be type VMN, VGN, VCPSB, or VFL as manufactured by Mason Industries, Inc.

C. Flexible Connections for HVAC Pumps (Rubber Expansion Joints)

1. Rubber expansion shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics and material. The raised face rubber flanges must encase solid steel rings to prevent pull out.

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- Flexible cable wire is not acceptable. Sizes 1-1/2" through 24"(40-mm through 350-mm) shall have a ductile iron external ring between the two spheres. Full faced rubber flanges are not acceptable through 24" diameter.
2. Sizes 1-1/2" through 14" (40-mm through 350-mm) shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" (400-mm to 600-mm) may be single sphere.
 3. Sizes 3/4" through 2" (19-mm through 50-mm) may have one sphere, bolted threaded flange assemblies and cable retention.
 4. Minimum ratings through 14" (350-mm) shall be 250psi at 170°F and 215psi at 250°F. (1.72 MPa at 77°C and 1.48 MPa at 121°C), 16"(400-mm) through 24" (600-mm) 180 psi at 170°F and 150 psi at 250°F. (1.24 MPa at 77°C and 1.03 MPa at 121°C). Higher published rated connections may be used where required.
 5. Safety factors shall be a minimum of 3/1. All expansion joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment.
 6. The piping gap shall be equal to the length of the expansion joint under pressure. Control rods passing through 1/2" (13-mm) thick Neoprene washer bushings large enough to take the thrust at 1000 psi (0.7 kg/mm²) of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the expansion joint rating without them.
 7. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 dB in vibration acceleration and 10 dB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.
 8. All expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.

D. Flexible Connections for Building Drainage and Storm Overflow (Rubber Expansion Joints)

1. Covers shall be minimum of 1 plies of Nylon skimmed with an elastomer to resist environmental conditions such as sunlight, ozone, oil particles, temperature or chemical exposure.
2. The carcass shall consist of a minimum of four plies of rubber impregnated Polyester or Kevlar tire cord. The fabric selection is a function of the operating temperature and pressure as specified in the joint schedule.
3. The expansion joint tube shall be a minimum of 1/4" thick and the elastomer as specified in the joint schedule. Abrasive resistance must be verified by an abrasive test in accordance with ASTM-D5963-04 and the material shall be capable of withstanding the temperature, corrosive and abrasive properties of the fluid. These capabilities shall be documented by the expansion joint manufacturer by test reports, recommendations of the elastomer supplier or an independent laboratory. Cover and tube tensile and elongation properties shall be documented by an independent laboratory report. Expansion joints shall be capable of meeting the movement requirements specified in the joint schedule.
4. All electrometric expansion joints from 1/2" to 120" in diameter shall be cured in a steam autoclave at a minimum pressure of 50 psi.
5. Back-up rings shall be A36 carbon steel, ductile iron or stainless, as specified.
6. The expansion joint manufacturer shall provide a set of calculations that will verify the structural carcass integrity. These design calculations shall include the fabric reinforcement

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- bias angle in the arch and body of the expansion joint, swell and expansion due to the operating pressures and the maximum stress on the fabric reinforcement.
7. Control units consisting of gusset plates, rods, nuts, and rubber washers for vibration and noise reduction must have calculations as well. Control units must be installed across all expansion joints if the pipeline is not anchored on both sides of the expansion joint. Materials shall be as in the schedule.
 8. All calculations for the structural carcass shall demonstrate a 3:1 safety factor on all components and materials.
 9. Calculations shall be stamped by a registered engineer in the states the project is located with a minimum of three (3) years of documented elastomeric expansion joint design experience.
 10. The same engineer shall document his presence in the facility while joints are manufactured.
 11. Single arch joints 30" diameter and larger, and all multiple arch joints shall be pressure tested to 1.5 of rated pressure for a period of 10 minutes minimum.
 12. Manufacturer's records shall reflect the actual cure cycle. The autoclave will be registered with the National Boiler and Pressure Vessel Association.
 13. Calculations, documentation of engineer's experience, pressure vessel certification and tensile, elongation and abrasion tests shall be submitted as part of the submittal package.
 14. Expansion joints shall be Series 450 as manufactured by the Mercer Rubber Company of Hauppauge, NY or approved equal.
- E. See architect drawing (A-120 Series) for isolation of incoming services.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All expansion devices shall be installed in accordance with the latest industry Standards, per the manufacturer's PE recommendations, or as indicated on the drawings.

3.2 APPLICATION

- A. All vibration isolators and seismic, wind restraint systems must be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic, wind restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system specified herein, nor degrades the performance of the building isolation bearings as specified in other sections.

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- D. The contractor shall not install any isolated components in a manner that makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Overstressing of the building structure must not occur due to overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. General bracing may occur from flanges of structural beams, upper truss cords in bar joist construction and cast in place inserts or wedge type drill-in concrete anchors.
- G. Seismic cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment or piping.
- H. Seismic cable assemblies are installed taut on non-isolated systems. Seismic rigid braces may be used in place of cables on rigidly attached systems.
- I. At locations where seismic cable restraints or seismic single arm braces are located, the support rods must be braced when necessary to accept compressive loads. (See Table "E".)
- J. At all locations where seismic cable braces and seismic cable restraints are attached to the pipe clevis, the clevis bolt must be reinforced with pipe clevis cross bolt braces or double inside nuts if required by seismic acceleration levels.
- K. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted.
- L. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraints shall be those described in the specification when horizontal motion exceeds 3/8".
- M. Special and Periodic Inspections for items listed in Section 1.4, Article B shall be conducted and submitted on a timely basis.
- N. Coordinate with other trades as required to avoid crossing the building isolation joint without providing a resilient connection.

3.3 EQUIPMENT INSTALLATION

- A. Equipment shall be isolated and/or restrained as per Tables A-E at the end of this section.
- B. Place floor mounted equipment on 4" actual height concrete housekeeping pads properly sized and doweled or expansion shielded to the structural deck to meet acceleration criteria (see Section 1.4). Anchor isolators and/or bases to housekeeping pads. Concrete work is specified under that section of the contract documents.
- C. Additional Requirements:

1. The minimum operating clearance under all isolated components bases shall be 2".
2. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.
3. All components shall be installed on blocks to the operating height of the isolators. After the entire installation is complete and under full load including water, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free to move in all directions, within the limits of the restraints.
4. Ceilings containing diffusers or lighting fixtures must meet seismic requirements by using earthquake clips or other approved means of positive attachment to secure diffuser and fixtures to T-bar structure.
5. All floor or wall-mounted equipment and tanks shall be restrained with Type V restraints.

3.4 PIPING AND DUCTWORK ISOLATION

A. Vibration Isolation of Piping:

1. HVAC Water Piping: All spring type isolation hangers shall be pre-compressed or pre-positioned if isolators are installed prior to fluid charge. If installed afterwards, field pre-compressed isolators can be used. All HVAC piping in the machine room shall be isolated as well as pressurized runs in other locations of the building 6" and larger. Type E hangers shall isolate horizontal pressurized runs in all other locations of the building. Floor supported piping shall rest on Type B isolators. Heat exchangers and expansion tanks are considered part of the piping run. The first 3 isolators from the isolated equipment shall have at least the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first 3 hangers shall have 0.75" nominal deflection or greater for pipe sizes up to and including 3", 1-3/8" nominal deflection or greater for pipe sizes greater than 3". Where column spacing exceeds 35', isolation hanger deflection shall be 2 1/2" for pipes exceeding 3" diameter. Type L hangers may be substituted for the above where isolation hangers are required.
2. Steam and Condensate Piping: All ceiling suspended piping in the mechanical equipment room shall be isolated with Type D hangers. All floor supported piping shall be supported with Type F isolators. At locations where supports are either acting as anchors or guides, Type D and F isolators shall be deleted, and anchor or guide shall be resiliently attached to the structure utilizing isolation washers and bushings to prevent metal to metal contact. Isolation washers and bushings shall be molded from Type "H" material.
3. Plumbing Water Lines: Plumbing water lines in the machine room shall only be isolated if connected to isolated equipment. (See Table B.) Isolator type shall be as listed in Article I, above.
4. Riser Location: All risers shall be supported on Type J or K anchors or guide restraints positively attached to both the riser and structure. Spiders welded to the pipe can substitute for Type K guides using J Type anchors.
5. Control Air Piping: Where control air piping is connected to isolated components, all piping shall be isolated, and equipment shall be flexibly connected in horizontal and vertical plane with Type FC-2 flexible connections.
6. Gas lines shall not be isolated.

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7. Fire protection lines shall not be isolated.
8. Where piping crosses the building isolation joint, provide a resilient connection to the un-isolated structure.
 - a. Where hangers are required, provide a Type C or D isolator so as to achieve a maximum natural frequency of 8 Hz.
 - b. Where floor supported mounts are required, provide a Type A, F, G, J, or K isolator so as to achieve a maximum natural frequency of 8 Hz.
 - c. Where lateral mounts are required, provide a Type M isolator so as to achieve a maximum natural frequency of 8 Hz.
9. Where piping penetrates the first-floor slab, oversize the penetration by 1" on all sides. Fill the penetration with fiberglass insulation, open-cell neoprene backer rod, and seal closed with non-hardening caulk.

B. Seismic Restraint of Piping, Conduit, Bus Duct and Cable Tray:

1. All high hazard and life safety pipe regardless of size such as fuel oil piping, fire protection mains, gas piping, medical gas piping and compressed air piping and piping with an $I_p = 1.5$ shall be seismically restrained or braced. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping. There are no exclusions for size or distance in this category.
2. Seismically restrain piping, with an $I_p = 1.0$, located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is 1-1/4" I.D. and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping.
3. Seismically restrain all other piping 2-1/2" diameter and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type VI seismic cable restraints or single arm braces may be used on non-isolated piping.
4. See Table D for maximum seismic bracing distances.
5. Multiple runs of pipe on the same support shall have distance determined by calculation.
6. Rod braces shall be used for all rod lengths as listed in Table E.
7. Clevis hangers shall have braces placed inside of hanger at seismic brace locations.
8. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided that they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
9. For fuel oil and all gas piping, transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
10. Transverse restraint for one pipe section may also act as longitudinal restraint for a pipe section of the same or smaller size connected perpendicular to it if the restraint is installed within 24" of the centerline of the smaller pipe or combined stresses are within allowable limits at longer distances.
11. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints. Use Type V or VI restraint, if trapeze is smaller than 48" long.
12. Branch lines may not be used to restrain main lines or cross-mains.
13. All fire protection branch lines shall be end tied.

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14. Where pipe passes through a fire-rated, seismic gypsum wall, the wall can act as a lateral/transverse brace for pipe sizes up to and including 6", provided fire stopping material is tight to the pipe.
15. Where pipe passes through a seismic block or concrete wall, the wall can act as a lateral/transverse brace.
16. Where horizontal pipe crosses a building's drift expansion joint, allowance shall be part of the design to accommodate differential motion.
17. Vertical pipe & conduit rises between floors shall have their differential movement part of the seismic design for building drift. Risers shall be anchored as required.
18. For horizontal passage of all underground utilities through building's foundation wall, all pipes shall pass freely through an oversized opening and waterproofed accordingly to accommodate maximum allowable building drift. (Seismic Restraint Type VIII)
19. Where piping, conduit, bus duct, cable, and cable trays cross the building isolation joint, provide a resilient connection to the un-isolated structure.
 - a. Where hangers are required, provide a Type C or D isolator so as to achieve a maximum natural frequency of 8 Hz.
 - b. Where floor supported mounts are required, provide a Type A, F, G, J, or K isolator so as to achieve a maximum natural frequency of 8 Hz.
 - c. Where lateral mounts are required, provide a Type M isolator so as to achieve a maximum natural frequency of 8 Hz.
20. Where piping, conduit, bus duct, cable, and cable trays penetrate the first-floor slab, oversize the penetration by 1" on all sides. Fill the penetration with fiberglass insulation, open-cell neoprene backer rod, and seal closed with non-hardening caulk.

C. Vibration Isolation of Ductwork

1. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Type A or Type E isolators. Actual spring deflection shall be a minimum of 0.75".
2. All duct runs having air velocity of 1500 feet per minute (fpm) or more shall be isolated from the building structure by Type E combination spring elastomer hangers or Type A floor spring supports. Spring deflection shall be a minimum of 0.75".
3. Where ductwork crosses the building isolation joint, provide a resilient connection to the un-isolated structure.
 - a. Where hangers are required, provide a Type C or D isolator so as to achieve a maximum natural frequency of 8 Hz.
 - b. Where floor supported mounts are required, provide a Type A, F, G, J or K isolator so as to achieve a maximum natural frequency of 8 Hz.
 - c. Where lateral mounts are required, provide a Type M isolator so as to achieve a maximum natural frequency of 8 Hz.
4. Where ductwork penetrates the first-floor slab, oversize the penetration by 1" on all sides. Fill the penetration with fiberglass insulation, open-cell neoprene backer rod, and seal closed with non-hardening caulk.

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D. Seismic Restraint of Ductwork

1. Restrain rectangular ductwork with cross sectional area of 6 square feet or larger. Type V seismic cable restraints or Type VI single arm braces shall be used on this duct. Duct that serves a life safety function or carries toxic materials in an "Essential or High Hazard Facility" must be braced with no exceptions regardless of size or distance requirements.
2. Restrain round ducts with diameters of 28" or larger. Type V seismic cable restraints or Type VI single arm braces.
3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
4. See Table D for maximum seismic bracing distances.
5. Duct must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze. Additional reinforcing is not required if duct sections are mechanically fastened together with frame bolts and positively fastened to the duct support suspension system.
6. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
7. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
8. If ducts are supported by angles, channels or struts, ducts shall be fastened to it at seismic brace locations in lieu of duct reinforcement.

EXEMPTIONS

1) EQUIPMENT:

- (a) Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.
- (b) Floor or curb-mounted equipment weighing less than 400 lbs and not resiliently mounted, where the Importance Factor, $I_p = 1.0$ and there is no possibility of consequential damage.
- (c) Equipment weighing less than 20 lbs and distribution systems weighing less than 5 lbs/lineal foot, with an $I_p = 1.0$ and where flexible connections exist between the component and associated ductwork, piping or conduit.
- (d) Chain supported lighting fixtures as described in Section 13.6.1 (ASCE 7-05).

2) DUCT (Applies to $I_p = 1.0$ only)

- (a) Rectangular, square, and oval air handling ducts less than six square feet in cross sectional area.
- (b) Round air handling duct less than 28 inches in diameter.
- (c) Duct runs supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork.

3) PIPING AND CONDUIT

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- (a) All high deformability pipe or conduit 3" or less in diameter suspended by individual hanger rods where $I_p = 1.0$.
- (b) High deformability pipe or conduit in Seismic Design Category D, E or F, 1" or less in diameter suspended by individual hanger rods where $I_p = 1.5$.
- (c) All clevis supported pipe or conduit runs installed less than 12" from the top of the pipe to the underside of the support point and trapeze supported pipe suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.
- (d) Piping systems, including their supports, designed and constructed in accordance with ASME B31.
- (e) Piping systems, including their supports, designed and constructed in accordance with NFPA, provided they meet the force and displacement requirements of Section 13.3.1 and 13.3.2 (ASCE 7-05).

EXEMPTIONS DO NOT APPLY FOR:

1) LIFE SAFETY OR HIGH HAZARD COMPONENTS

- (a) Including gas, fire protection, medical gas, fuel oil, and compressed air needed for the continued operation of the facility or whose failure could impair the facility's continued operation, Occupancy Category IV, IBC-2006 as listed in Section 1.3 B regardless of governing code for HVAC, Plumbing, Electrical piping or equipment. (A partial list is illustrated.) High Hazard is additionally classified as any system handling flammable, combustible or toxic material. Typical systems not excluded are additionally listed below.

2) ELECTRICAL

- (a) Includes critical, standby or emergency power components including conduit (1" nominal diameter and larger) cable tray or bus duct, lighting, panels, communication lines involving 911, etc.

3) PIPING

- (a) Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers, and mains. Fire Sprinkler Branch Lines must be end tied.

4) DUCT

- (a) Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override.

5) EQUIPMENT

- (a) Previously excluded non-life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers, and humidifiers having a weight greater than 75 lbs require independent seismic bracing.

6) BUILDING ISOLATION JOINT

- (a) Components which cross the building isolation joint as described in previous sections.

3.5 FIELD QUALITY CONTROL, INSPECTION

- A. All Independent Special and Periodic Inspections must be performed and submitted on components as outlined in Section 1.4 B, Article 4. (See also Contractor Responsibility, Section 1.4B, Article 5.) Note: Special Inspection services are to be supplied by the Owner.
- B. Upon completion of installation of all vibration isolation devices, the manufacturer's chosen representative shall inspect the completed project and certify in writing to the Contractor that all systems are installed properly or list any that require correction. The contractor shall submit a report to the Architect, including the representative's report, certifying correctness of the installation or detailing corrective work to be done.

4.0 Selection Guide for Vibration Isolation and Seismic Restraint

TABLE "A" HVAC EQUIPMENT										
EQUIPMENT (See Notes)	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
	Size/Type	Mtg	Isol	Nom Defl*	Base	Restr	Isol	Nom Defl*	Base	Restr
Air Handling Units Indoor		Floor	B	0.75	---	IV	B	1.5	---	IV
		Ceiling	---	---	---	---	E	0.75	---	V
Air Compressor, Tank or Floor Mounted	To 10 HP	Floor	B	0.75	---	IV	B	1.50	---	IV
	>10 HP	Floor	B	0.75	B-2	IV	B	1.50	B-2	IV
Dry Coolers Outdoor Condensing Units/Condensers		Roof	---	---	---	IV	B	2.50 Minimum	B-5	IV
Axial Fans (Inline Type)		Floor	B	0.75	---	IV	B	See Guide	---	IV
		Ceiling	---	---	---	---	E	See Guide	---	V
Base Mounted Pumps	To 15 HP	Floor	B	0.75	B-2	IV	B	0.75	B-2	IV
	>15 HP	Floor	B	0.75	B-2	IV	B	1.50	B-2	IV
Boilers		Floor	G	0.10	---	IV	B	0.75	---	IV
Cabinet Fans & Packaged AHU Indoor	To 1 HP	Floor	F	0.20	---	IV	B	0.75	---	IV
		Ceiling	---	---	---	---	E	0.75	---	V
	>1 HP	Floor	B	0.75	---	IV	B	See Guide	---	IV
		Ceiling	---	---	---	---	E	See Guide	---	V
Centrifugal Fans Arr. 1 & 3	Class 1	Floor	B	0.75	B-1	IV	B	See Guide	B-1	IV
	Class 2 & 3	Floor	B	0.75	B-2	IV	B	See Guide	B-2	IV

Centrif. Fans (Vent Sets) Arr. 9 & 10	Class 1	Floor	B	0.75	---	IV	B	See Guide	See Note 4	IV
	Class 2 & 3	Ceiling	---	---	---	---	E	See Guide	B-2	V
Computer Room Units		Floor	F	0.20	B-7	IV	B	1.5	B-7	IV
Condensate Pumps		Floor	F	0.20	If req.	IV	F	0.20	If req.	IV
Cooling Towers		Floor	B	0.75	---	IV	B	2.50	B-1, B-5 optional	---
Curb Mtd. Equip. (Non-Isol.)		Roof	---	---	---	IV	---	---	B-6	---
Fan Coil Units		Floor	F	0.20	---	IV	B	0.75	---	IV
		Ceiling	---	---	---	---	E	0.75	---	V
Outdoor Reciprocating, Rotary or Screw Chillers		Floor	F	0.20	---	IV	B	1.50	---	---
		Roof	---	---	---	IV	B	2.50	B-5	---
Rooftop AHU/AC (curb mounted)	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-3 See Notes 5,6	---
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-3 See Notes 5,6	---
Rooftop AHU/AC (dunnage mounted)	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-8	---
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-8	---

* See Minimum Deflection Guide for Equipment with Low RPM.

TABLE "B" PLUMBING EQUIPMENT										
EQUIPMENT (See Notes)	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
	HP	Mtg	Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Air Compressors & Vacuum Pumps	Up to 10	Floor	B	0.75	---	IV	B	1.50	---	IV
	Over 10	Floor	B	0.75	B-2	IV	B	1.50	B-2	IV
Base Mounted Pumps	Up to 15	Floor	B	0.75	B-2	IV	B	0.75	B-2	IV
	Over 15	Floor	B	0.75	B-2	IV	B	1.50	B-2	IV

TABLE "C" ELECTRICAL EQUIPMENT										
EQUIPMENT (See Notes)	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
	Size	Mtg	Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Transformers (Dry Type)	All	Floor	---	---	---	IV	D	0.30	*	IV
		Ceiling	---	---	---	V	E	0.20	*	V
Generators	All	Floor	B	1.0	---	IV	B	1.50	*	IV
Generators	All	Over Occupied Space	---	---	---	---	B	2.50	*	IV
UPS Systems	M	All	---	---	---	---	B	1.50	*	IV

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*Where Component cannot be point supported, Base Type B-1 shall be used.

Minimum Deflection Guide for Equipment with Low RPM

Lowest RPM of Rotating Equipment	Minimum Actual Deflection
Less Than 400	3.5"
401 thru 600	2.5"
601 thru 900	1.5"
Greater than 900	0.75"

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General Notes for All Tables:

1. Abbreviations:
 - a. Mtg = Mounting
 - b. ol = Vibration Isolator Type per Section 2.2, Vibration Isolation Types
 - c. Defl = Minimum Deflection of Vibration Isolator
 - d. Base = Base Type per Section 2.4, Equipment Bases
 - e. Restr = Seismic Restraint Type per Section 2.3 Seismic Restraint Types
2. All deflections indicated are in inches.
3. For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide.
4. For roof applications, use Base Type B-5.
5. Specification Option #1 called out on equipment schedule in Curb Type B-3 shall use sound barrier RPFMA when there is no concrete under rooftop units and this option is selected. Curbs can be used for return plenums. (See Option #1 under Curb Type B-3.)
6. Specification Option #2, called out on equipment schedule in Curb Type B-3 shall be used where curbs require supply and return sound attenuation package Type SPFMA shall be used. (See Option #2 under Curb Type B-3.)
7. Units may not be capable of point support. Refer to separate air handling unit specification section. If that section does not provide base and external isolation is required, provide Type B-1 base by this section for entire unit.
8. Static deflection shall be determined based on the deflection guide for Table "A."
9. Deflections indicated are minimums at actual load and shall be selected for manufacturer's nominal 5", 4", 3", 2", and 1" deflection spring series; RPM is defined as the lowest operating speed of the equipment.
10. Single stroke compressors may require inertia bases with thicknesses greater than 14" maximum as described for Base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8".
11. For floor mounted fans, substitute Base Type B-2 for Class 2 or 3 or any fan having static pressure over 5".
12. Indoor utility sets with wheel diameters less than 24" need not have deflections greater than 0.75".
13. Curb-mounted fans with curb area less than 9 square feet are excluded.
14. For equipment with multiple motors, Horsepower classification applies to largest single motor.
15. Engineer's Note: When either note #s 3 or 4 apply to the project, Type RPFMA Option #1, or Type SPFMA Option #2 sound attenuation systems, the use of options #1 or #2 shall appear as a note clearly called out on the equipment schedule for either of these options to apply.

4.1 Spacing Chart for Suspended Components

Table "D" Seismic Bracing (Maximum Allowable Spacing Shown - Actual Spacing to be Determined by Calculation)			
Equipment	On Center Transverse	On Center Longitudinal	Change of Direction
Duct			
All Sizes	30 Feet	60 Feet	4 Feet
Pipe Threaded, Welded, Soldered or Grooved; Conduit and Conduit Racks			
To 16"	40 Feet	80 Feet	4 Feet
18" - 28"	30 Feet	60 Feet	4 Feet
30" - 40"	20 Feet	60 Feet	4 Feet
42" & Larger	10 Feet	30 Feet	4 Feet
Pipe - No Hub or Bell and Spigot			
2.5" & Larger	10 Feet	20 Feet	4 Feet
Boiler Breeching	30 Feet	60 Feet	4 Feet
Chimneys & Stacks	30 Feet	60 Feet	4 Feet
Conduit	40 Feet	80 Feet	4 Feet
Bus Duct	20 Feet	40 Feet	4 Feet
Cable Tray	40 Feet	80 Feet	4 Feet

4.2 Vertical Hanger Rod Bracing Schedule

Table "E" Hanger Rod Bracing Schedule (Stiffener to be maximum 6" from end of rod)					
Rod Dia.	Clamp Size	Maximum Un-braced Rod Length	Steel Angle Size	Clamp Spacing	Min # of Clamps per Stiffener
3/8"	SRC-1	19"	1 x 1 x 1/4"	16"	2
1/2"	SRC-1	25"	1 x 1 x 1/4"	20"	2
5/8"	SRC-1	31"	1 x 1 x 1/4"	24"	2
3/4"	SRC-1-1/2	37"	1-1/2 x 1-1/2 x 1/4"	28"	2
7/8"	SRC-1-1/2	43"	1-1/2 x 1-1/2 x 1/4"	33"	2
1"	SRC-1-1/2	50"	1-1/2 x 1-1/2 x 1/4"	40"	2
1-1/8"	SRC-2	62"	1-1/2 x 1-1/2 x 1/4"	50"	2

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FORM CQAP
FOR USE GROUP III PROJECTS, IBC-2000,
OCCUPANCY CATEGORY IV PROJECTS, IBC-2003-2006

Section 230548
Vibration Isolation and Seismic Restraints

Contractor Name: _____

Date: _____

Project: _____

Specification Section: _____

Contractor IBC Quality Assurance Seismic Program

This form is to be filled out as the identifying document for the Contractor's Quality Assurance Program (see Contractor Responsibility Section 1.4B, Article 4) before the first submission in any vendor group by the installing contractor. All items listed herein shall be part of that program.

1. Acknowledge special requirements contained in the quality assurance plan.
2. Acknowledge that control will be exercised to obtain conformance with the construction documents.
3. Procedures for exercising control within the contractor's organization including frequency and distributions of inspections and testing reports.
4. Identification and qualification of the persons exercising control of this program within their organization.

Contractor to submit this program acknowledging receipt and program implementation. Each of the 4 listed programs are to be submitted including all applicable details as listed above.

Signature

Print Name

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FORM CVC-1
FOR USE GROUP III PROJECTS, IBC-2000 &
OCCUPANCY IV PROJECTS, IBC-2003-2006

Section 230548
Vibration Isolation and Seismic Restraints

Contractor Name: _____

Date: _____

Project: _____

Specification Section: _____

Notes to the Installing Contractor

The purpose of this form is for you, the contractor to fill in all vendors that are IBC compliant as part of your initial submission for any group of equipment, i.e., fans, AC units, pumps, etc. It is acceptable to submit vendors that will be compliant as long as a factory letter is issued stating full compliance will occur at time of shipment. Only IBC compliant vendors can participate on this project. In the event that no vendor in any group is IBC compliant, this information must be submitted to the Project's MEP for approval.

Manufacturer	IBC Compliant	
	Yes	No

Signature

Print Name

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FORM SQA-1
FOR USE GROUP III PROJECTS, IBC-2000,
OCCUPANCY CATEGORY IV PROJECTS, IBC-2003-2006.

Section 230548
Vibration Isolation and Seismic Restraints
Seismic Quality Assurance Plan for The Installation of Life Safety
And High Hazard Systems (Inspections)

Contractor Name: _____

Date: _____

Project: _____

Specification Section: _____

The following are required for the Seismic Quality Assurance Installation Plan for Life Safety and High Hazard systems to be prepared and submitted by each installing contractor (see Contractor's Responsibilities Paragraph 1.4B, Article 5). This plan must reflect all of the provisions and reports outlined in the paragraph below. As part of this contractor's final requisition, this form must accompany, along with all satisfactorily completed tests and reports, the final payment's request including all applicable certification reports.

- Special field inspection and testing is required by IBC Sections 1704, 1707, and 1708 during the installation of Life Safety and High Hazard System components including equipment, piping and all electrical connections. Components must be inspected by a Building Official or approved independent special inspector periodically during the course of installation. Contractor shall submit such inspection reports as part of his project wrap up for each group of equipment, components so requiring this program. All components, which are Life Safety, designate or Handle Hazardous substances fall into this category. Typical Life Safety and High Hazard components as well as non-life safety components listed in that section are outlined in 1.3 B of the SGMEC® Specifications.

Signature

Print Name

Revision History

Rev.	Description	Date	By
0	Initial VMC Release	08/12/2009	JPG
1	Revised to include integrated product names	12/2009	RCB
2	Revised to include B-8,9,&10 & Steam and Condensate Notes	01/29/2010	RCB

END OF SECTION

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SECTION 23055

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

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. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

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1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

- 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
- 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 4. Fasteners: Stainless-steel rivets or self-tapping screws.
- 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

- 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- 2. Letter Color: White.
- 3. Background Color: Black.
- 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 7. Fasteners: Stainless-steel rivets or self-tapping screws.
- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

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- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

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2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Brass.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS SCHEDULE AND RISER DIAGRAM

- A. Valve Tags: 2" round Stamped or engraved with 1" high numbers & 1/4" high letters for piping system.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system provide A CD in excel format and one line diagram in AutoCAD format (2004 or later). Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule and one line diagram shall be included in operation and maintenance data.
 - 2. Schedule shall indicate tag number, valve location by floor and nearest column number, valve size and type, and service controlled.
 - 3. One-line diagram shall indicate tag number, valve size and type, service controlled, direction of flow, and location and designation of equipment served.
- C. Furnish to Owner's Representative three (3) framed plastic laminated valve tag schedules and one-line diagrams of the complete system. Also furnish two (2) framed plastic laminated valve tag schedules and one-line diagrams specific for each MER.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

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1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Color Schedule: To be per building or owner standard. If no standard exists provide per ANSI standards.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units.

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3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

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SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

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.
- B. Vibration, seismic, wind & flood criteria for this vendor is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section in its entirety.
- C. VOC Limits for Adhesives, Sealants, Paints and Coatings Section 018101
- D. Construction and Demolition Waste Management Section 018102
- E. Construction Indoor Air Quality (IAQ) Management Section 018103
- F. Mechanical Commissioning Section 230800

1.2 SUMMARY

- A. Section includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems
 - b. Variable-air-volume systems
 - c. Smoke Purge and pressurization systems
 - d. Guestroom Heat Pump Units
 - e. Exhaust Systems
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems
 - b. Variable-flow hydronic systems
 - c. Heat Exchangers
 - d. Boilers & Equipment

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e. Guestroom and Public Space Heat Pump Units

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 15 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

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1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB as a TAB technician.
 3. TAB shall employ a professional engineer registered in state in which services are to be performed.
- B. TAB Conference: Meet with Architect, Owner, Construction Manager, and Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
1. Agenda items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect, Engineer Owner, Construction Manager, Commissioning Authority.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 HVAC CONTRACTOR RESPONSIBILITIES

- A. Prepare each system for testing and balancing and for all equipment into full automatic operation with the final filters in place.
- B. Cooperate with the testing agencies, provide access to all work, equipment and systems. Operate individual equipment and systems as requested by the testing and balancing agency.
- C. Put all heating, ventilating and air conditioning systems and equipment and building management systems into full operation and shall continue the operation of same during each working day of testing and balancing. Operate systems and under conditions required for proper testing, adjusting, and balancing.
- D. Notify Testing Agency's project manager, Owner and Engineer TWO WEEKS prior to time system will be ready for testing, adjusting, and balancing. Project readiness shall include:
 - 1. Systems are started and running (fans and pumps have been checked for proper rotation).
 - 2. Permanent electrical power wiring is complete.
 - 3. Verification that all ductwork is fabricated and installed as specified.
 - 4. Ceilings are installed in critical areas where diffuser air pattern adjustment may be required. Access to balancing devices is provided.
 - 5. All equipment and ductwork access doors are securely closed.
 - 6. A complete review of the Contractor Coordination Drawings for coordination of the provisions for the TAB process and instrumentation needed.
 - 7. All balancing, smoke and fire/smoke dampers are installed and in full open positions.
 - 8. All isolation and balancing valves are open and control valves are operational.
 - 9. System installation is complete, with Controls and Instrumentation installed and fully operational.
- E. Where fans (air handling units, supply fans, return fans, exhaust fans, etc.) are provided with variable pitch sheaves, TAB Contractor shall adjust sheaves, as required. At no additional cost to the Owner, until desired Design Points (CFM and Static Pressure) are reached. If adjustment of the variable pitch sheaves is beyond the range of the sheaves, HVAC Contractor shall replace sheaves, as required, at no additional cost to the Owner, until the desired Design Points (CFM

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and Static Pressure) are reached. Where fans (air handling, supply, return, exhaust, etc.) are specified with fixed ratio sheaves, HVAC Contractor shall provide a set of variable sheaves for initial adjustment and determination of proper RPM. TAB contractor shall notify HVAC Contractor of the correct fixed sheave selection. HVAC Contractor shall provide the proper fixed sheaves to the TAB Contractor who shall replace the variable sheaves and provide a final report verifying performance. This work shall be at no additional cost to the Owner until desired Design Points (CFM and Static Pressure) are reached. Where fans (air handling units, supply fans, return fans, exhaust fans, etc.) are of the vane axial type with adjustable vanes, TAB Contractor shall, at no additional cost to Owner, adjust vanes as required until desired Design Points (CFM and/or Static Pressure) are reached.

- F. The HVAC contractor shall be responsible for the leakage testing of the ductwork under the direction and supervision of the Testing and Balancing Agency. The HVAC Contractor shall provide the required equipment and labor for testing. The TAB contractor shall provide any special instrumentation and record all data for submittal to the CM and CA. The CA shall be given two weeks prior notification of and be present during initial testing. Subsequent testing shall be coordinated with and witnessed by the CM.
- G. All ductwork etc. that is found to exceed the permissible leakage rates shall be immediately repaired by the HVAC contractor, at no additional cost to the Owner and in a timely manner so as not to interfere with the progress of the work.

1.9 WARRANTY

- A. The Mechanical Contractor in conjunction with the test and balance agency shall include an extended warranty of 180 days after submission of the certified balancing report. Owner may elect to obtain the services of an independent certified test and balance agency to verify reports submitted by the Mechanical Contractors' test and balance agency. The Mechanical Contractors' shall provide technicians to assist the Owner's Test and Balancing agency in making any tests and adjustments he may require during this period of time. All deficiencies reported by the Owner's test and balance engineer shall be corrected by the Mechanical Contractor. Any and all costs associated with correction of report deficiencies shall be borne by the Mechanical Contractor. Any and all costs incurred by Owner to correct work due to the Mechanical Contractors' failure to correct the deficiencies within 15 working days from notice of deficiencies shall be borne by the Mechanical Contractor.

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PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment. On existing systems visit site survey and record equipment model and serial numbers and obtain equipment performance data from respective manufacturer including but not limited to fan curves, pump curves and motor data.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Ductwork" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

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- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

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3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 HYDROSTATIC PRESSURE TESTING

- A. Before piping of various systems is insulated, furred in or otherwise covered, hydrostatic leak tests shall be conducted as specified below:
 - 1. Vents shall be provided at all high points of the piping system in the position, in which the test is to be conducted to purge air pockets while the component or systems is filling. Venting during the filling of the system may be provided by the loosening of flanges having a minimum of four bolts or by the use of equipment vents.
 - 2. Liquid for each hydrostatic test of piping other than domestic water piping shall be water and Nalco 2572 or approved equal mixed to a ratio of fifty (50) gallons of Nalco 2572 to 10,000 gallons of water or a higher concentration if recommended by the chemical manufacturer. The process shall be monitored by the chemical treatment manufacturer and a written report issued to the Engineer and Owner two weeks after completion of the Contractor's hydrostatic testing. At least sixty (60) days prior to the start of hydrostatic leak testing a 2' long length of the typical piping installed on the Project shall be sent by the Contractor to Nalco or another chemical manufacturer acceptable to the Owner to

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determine the composition of the internal pipe coating. Provide injection pumps, water meters and coupon racks to control and monitor the concentration. After leak testing and a sufficient time period to allow the interior of the piping to be chemically coated to prevent rust formation, the piping shall be drained until empty. Liquid for hydrostatic testing of domestic water systems shall be clean domestic water.

3.5 CLEANING AND LEAKAGE TESTING OF DUCTWORK

- A. The open ends of all unfinished sections of ductwork, including fan outlets, tapping's for air outlets, etc., shall be properly capped in an approved manner at all times during construction at the end of each working day, unless the particular section of ductwork is actually being worked on.
- B. The requirement for approved capped duct openings shall continue until white plastering or equivalent finishing operations in the buildings are completed.
- C. If the above requirements have not been strictly adhered to by the Contractor and enforced during the entire construction period, cover all air supply and return outlets with cheesecloth and blow out the duct system to the satisfaction of the Construction Manager.
- D. Provide for the proper sealing of all duct lining joints and entering edges of lining to assure that there is no exposed fiber within the air stream.
- E. The leakage testing of medium and low pressure ductwork shall comply with the following:
 - 1. General: Systems shall be tested for leakage before insulation is applied.
 - a. After portions of the Work are completed, the following tests shall be made in the presence of the Owner's representative, Engineer, CA, and/or CM. Ten (10) working days advance written notice of the tests shall be given to the CM, who in turn will notify other parties interested. A meeting will be arranged for the initial leak testing of ductwork in order to assure a proper understanding of these requirements. Subsequent testing will be witnessed by the CM.
 - 2. Air leakage testing during erection shall include separate leakage air tests of built up air handling casings, discharge and intake plenums, machine room duct, complete and/or partial air risers, each completed and/or partial horizontal distribution system, and, after all ductwork is installed and central station apparatus is erected, leakage testing of the pressure side of the whole system up to the inlet of the variable air volume and fan powered terminal unit boxes. Test ducts/casings with positive pressure on the discharge side of the system fan and under negative pressure on the suction side of the system fan. Include testing of flexible run outs. It is the intent of the Specifications that ductwork

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- shall be tested in sections, if required, or as directed by the Construction Manager in order to permit work of other Trades to proceed.
3. Tests shall be made during installation using suitable test equipment, including "U" tube, orifice, tubing and cocks, arranged to indicate the amount of air leakage. Furnish all gauges, blowers, instruments, test equipment and personnel required for tests, and make all provisions for removal of test equipment after tests have been made. The blower shall maintain the required test pressure differential across the orifice plate. Leaks, which cause an air loss greater than the permissible leakage rate, defined below and, noisy or whistling leaks, shall be repaired and a retest made.
- F. After the acceptance of the tests by the owner, the branches shall be connected to the risers and the ductwork shall be released for insulation.
- G. The leakage testing of ductwork shall be made with pressure in ductwork maintained per the table below, but not less than the pressure rating of the system, obtained by operation of the air supply fan or, if fan cannot be operated, by the use of the test blower(s). All joints shall be inspected and checked for leakage, by means, as directed. Even if a duct section passes the leakage test, all audible leaks shall be sealed. Test procedure shall be in accordance with the test procedure outlined in SMACNA "HVAC Air Duct Leakage Test Manual", Second Edition, 2012.
- H. The following ductwork systems shall be field leak tested:
1. All supply and return ductwork from air conditioning equipment to inlet side of VAV boxes.
 2. All supply and return ductwork risers in vertical shafts.
 3. All constant volume supply and return trunk ductwork on systems over 2" S.P from air handler to branch take offs.
 4. All kitchen exhaust systems.
 5. All systems rated at 4" S.P. and over.
 6. All toilet exhaust risers in shafts.
 7. All smoke control systems.

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I. Test all systems in accordance with the following:

Ductwork Rated Pressure (in. w.g.)	Leakage Test Pressure, P (in. w.g.)	Duct Seal Class	Rectangular		Round/Flat Oval	
			Duct Leakage Class, C _L	Leakage Allowed, F	Duct Leakage Class, C _L	Leakage Allowed, F
Ducts Located Indoors						
0.5	0.5	A	16	10.2	8	5.1
1	1	A	16	16.0	8	8.0
2	2	A	16	25.1	8	12.6
3	3	A	8	16.3	4	8.2
4	4	A	4	9.8	2	4.9
6	6	A	4	12.8	2	6.4
10	10	A	4	17.9	2	8.9
Ducts Located Outdoors						
0.5	0.5	A	4	2.5	4	2.5
1	1	A	4	4.0	4	4.0
2	2	A	4	6.3	4	6.3
3	3	A	4	8.2	4	8.2
4	4	A	4	9.8	4	9.8
6	6	A	4	12.8	4	12.8
10	10	A	4	17.9	4	17.9
Welded Ducts Located Indoor/Outdoor						
3	3	Welded	3	6.1	2	4.1
4	4	Welded	3	7.4	2	4.9
6	6	Welded	3	9.6	2	6.4
10	10	Welded	3	13.4	2	8.9

Leakage allowed calculated as follows: $F = (C_L)(P^{0.65})$

Where:

F = Allowable Leakage rate in cfm/100 sf of duct surface

C_L = Leakage Class

P = Test static pressure

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

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- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."
- M. Air systems shall be balance with clean air handling unit filters or with the electronic air cleaner fully operational. All required filter changes shall be by the airside HVAC Contractor. Fan belt tension shall be checked prior to balancing and adjusted as required. Air handling units and fans with duct pressure controls or automatic flow control systems shall have the controllers adjusted to maintain the specified pressure or flow prior to balancing. The HVAC Contractor that purchased the units shall operate and maintain the washing cycles of electronic air cleaners when specified and furnish all water and washing fluids consumed during testing and air balancing.
- N. Supply air systems installed in finished areas with inaccessible ceiling construction shall be balanced and adjusted as follows:
 - 1. After duct systems have been installed complete with all dampers, ducts, coils and other items hereinafter specified, except for final connection to grille or air outlet and prior to inaccessible ceiling installation, the TAB Contractor shall make adjustments, as required, to deliver the volume of air at each interior and perimeter air tap proportionally within ten (10%) percent of design flow as shown on the Drawings.
 - 2. After each duct system has been adjusted the Subcontractor shall securely lock each manual damper, splitter, spin-in damper, etc., with sheet metal screws prior to installation of ceiling.

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3. The TAB Contractor shall submit balancing reports to the Engineer for review and comment as specified hereinafter, prior to the installation of the inaccessible ceiling. No duct system shall be concealed prior to the TAB Contractor being in receipt of an "Approved" air balance report for the system.
4. After ceiling installation, each air outlet shall be installed with air patterns as shown on the Drawings or as directed by the owner. Final air balance adjustment shall be made by increasing or decreasing the air handling unit fan rpm.

3.7 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Engineer or Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections

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- for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- E. Guestroom Heat Pump Units
1. Work in conjunction with heat pump manufacturer's field service technician to adjust all ECM motors to deliver specified air quantities at Hi-Medium-Lo speeds.
 2. Revisit site after 90 days of completion in conjunction with heat pump manufacturer's field service technician to make adjustments as directed by Owner.

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3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. **Compensating for Diversity:** When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. **Pressure-Independent, Variable-Air-Volume Systems:** After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record final fan-performance data.

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3.9 PROCEDURES FOR SMOKE PURGE & PRESSURIZATION SYSTEMS

- A. General: All tests shall be performed as specified herein and in accordance with the procedures and test criteria established by the local authorities having jurisdiction. The mechanical, fire protection, fire alarm, electrical, BMS Contractor, Commissioning Agent and the CM shall be present and shall participate during the entire testing procedures. The TAB Contractor shall furnish the smoke bombs.
 - 1. The TAB Contractor shall verify and record that the quantity of air indicated on the Drawings is exhausted at the smoke removal inlet and shall verify and record the quantity of air flowing through the exhaust fan. Tests shall demonstrate the proper sequence of the fire safety ventilation system, the activation of the smoke detection system, smoke exhaust system and makeup air from the stairwell systems. The smoke management systems installed in the Project shall be performance tested in accordance with the requirements of the authorities having jurisdiction and the Fire Department. The demonstration tests shall be conducted and repeated until they are accepted and approved by the authorities having jurisdiction. The TAB Contractor shall include all costs associated with the required demonstration tests, including smoke bombs, instrumentation, etc.
- B. Stairwell Pressurization Systems
 - 1. The stairway pressurization systems shall be tested after the stairway shaftway has been checked for leaks, cracks, door seal function, etc. Smoke bombs shall be activated in the stairway to verify tightness of enclosure. The maximum differential pressure at any point in the stairway between the stairway and the building shall not exceed 0.20" w/g/ with all doors closed. The minimum differential pressure at any point between the stairway and the building shall not be less than 0.15" w.g. with all doors closed. The pressurization system shall provide a minimum air velocity of 300 feet per minute through the open door farthest from the pressurization source, and on (1) other open door at the center of the shaft.
- C. Post Event Smoke Purge
 - 1. Each floor with smoke exhaust systems shall be performance tested by demonstration of the proper sequences of the fire safety ventilation system, automatic damper operation and other functions involved. Test shall demonstrate the activation of the smoke detection system, smoke exhaust system and the makeup air systems.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Engineer or Commissioning Authority and comply with requirements in Division 23 Section "Hydronic Pumps."
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

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- a. Monitor motor performance during procedures and do not operate motors in overload conditions.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.
- B. Chilled Water system: After the system is initially balanced with the injection pump operating put system in "Bypass" mode utilizing campus chilled water only, injection pumps will be in-operative. Take readings for all systems as specified above.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR HEAT EXCHANGERS & WATER COOLED CONDENSERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet and outlet pressures.
- E. Check settings and operation of safety and relief valves. Record settings.

3.15 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper

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operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

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3.17 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
 - 2. Air Outlets and Inlets: Plus or minus 5 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 5 percent.
 - 4. Cooling-Water Flow Rate: Plus or minus 5 percent.

3.18 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.19 FINAL REPORT

- A. General: Prepare a minimum of 6 copies of a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.

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- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.

7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft.
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.

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- g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
 - 1. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.

- b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:

- a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data (indicated and actual values):
- a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.

L. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.20 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 10 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect, Owner, Construction Manager and Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect, Owner, Construction Manager and Commissioning Authority.
3. Architect, Owner, Construction Manager and Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

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2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.21 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

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SECTION 230700
HVAC INSULATION

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. Insulation materials:
 - a. Calcium silicate.
 - b. Cellular glass.
 - c. Flexible elastomeric.
 - d. Mineral fiber.
 - e. Phenolic.
 - f. Polyisocyanurate.
 - g. Polyolefin.
 - h. Polystyrene.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. Corner angles.

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B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Ductwork" for duct liners.
4. Division 33 Section "Underground Hydronic Energy Distribution" for loose-fill pipe insulation in underground piping outside the building.
5. Division 33 Section "Underground Steam and Condensate Distribution Piping" for loose-fill pipe insulation in underground piping outside the building.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1. Sample Sizes:

- a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
- b. Sheet Form Insulation Materials: 12 inches square.
- c. Jacket Materials for Pipe: 12 inches long by NPS 2.
- d. Sheet Jacket Materials: 12 inches square.
- e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

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- E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- F. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

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1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.2 PIPE INSULATION

- A. Type P-1: Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, ASTM C547 glass fiber pipe insulation with thermal conductivity (k factor) not exceeding $0.23 \text{ (Btu} \times \text{In)} / \text{(Hr} \times \text{Ft}^2 \times \text{deg F)}$ at 75 deg F mean temperature. Insulation shall be jacketed with white reinforced all service vapor retarding jacketing. Vapor barrier mastic shall be Foster 30-80 or Childers CP-35. Adhesive shall be Childers CP-82. At the Subcontractor's option, self-sealing lap jacketing with adhesive release strips on both the lap and the jacket may be used. No exposed staples will be allowed. Fiberglass insulation shall be installed in all areas where the piping system is exposed within ducts or in return and supply air plenums. Provide one of the following:

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- a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A.
 3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A.
- B. Type P-2: Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Products: Subject to compliance with requirements, Trymer 2000 by ITW Insulation, polyisocyanurate foam pipe insulation with thermal conductivity (k factor) not exceeding $.19 \text{ (Btu x In) / (Hr x Ft}^2 \text{ x deg F)}$ at 75 deg F mean temperature. Insulation shall be jacketed with Saran, 560 or 520 PVDC vapor retarder tape and film with self sealing tape. ASJ paper is not acceptable. Each 36" long pipe insulation section shall be additionally secured with filament tape or 2" Saran tape double-wrapped centered on 15". Vapor barrier mastic shall be Foster 85-20 or Childers CP-35. Adhesive for laps shall be Foster 85-75 or Childers CP-82. Pumps, Valves and Fittings shall be the fabricated trymer with 20 X 20 glass fabric sealed with Foster 80-20 vapor barrier mastic. Type B polyisocyanurate foam insulation shall be installed only on chilled and heating hot water piping (not exceeding 300 deg F) or equal. Comparable products subject to compliance with the requirements by one of the following:
 - a. Apache Products Company.
 - b. Duna USA Inc.
 - c. Dupont.
 - d. Elliott Company.
 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed $0.19 \text{ Btu x in./h x sq. ft. x deg F}$ at 75 deg F after 180 days of aging.
 3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
 4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
- C. Type P-3: Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Products: Subject to compliance with requirements, Armstrong Type AP Armaflex or Rubatex R180-FS 25/50 rated flexible elastomer pipe insulation. Insulation shall have a thermal conductivity (k factor) of not more than $0.28 \text{ (Btu x In) / (Hr x Ft}^2 \text{ x deg F)}$ at 75

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deg F mean temperature when tested by ASTM C177 and a water vapor permeability of 0.20 or less when tested by ASTM C355 water method. Adhesive shall be Armaflex 520 BVL. Comparable products subject to compliance with the requirements by one of the following:

- a. Aeroflex USA Inc.; Aerocel.
- b. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

D. Type P-4: Calcium Silicate:

1. Products: Subject to compliance with requirements, Hydrous calcium silicate non-asbestos insulation similar to Schuller Thermo-12 Gold. The insulation shall have an average thermal conductivity (k factor) not exceeding $0.42 \text{ (Btu x In) / (Hr x Ft}^2 \text{ x deg F)}$ at a mean temperature of 300 deg F. Insulation shall be finished with Ramcote 1200 or Pro-Tec-T-Kotes "V" One Coat high temperature finishing cement. All materials shall be suitable for 1200 deg F service. Comparable products subject to compliance with the requirements by one of the following:

- a. Industrial Insulation Group (The); Thermo-12 Gold.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

E. Type P-5: Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Knauf Insulation; Permawick Pipe Insulation.
 - b. Owens Corning; VaporWick Pipe Insulation.

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2.3 DUCT INSULATION

- A. Type D-1: Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290. Fiberglass flexible blanket type insulation 0.75 pound density, 1-1/2" thick with a reinforced foil vapor barrier facing. The insulation shall be secured to the ducts with Childers CP-85, Benjamin Foster No. 85-20 or Minnesota Mining EC-1329 adhesive applied in 6" wide strips on approximately 12" centers. Where rectangular ducts are 24" in width or greater, duct wrap insulation shall be additionally secured to the bottom of the duct with mechanical fasteners such as pins and speed clip washers, spaced on 18" centers (maximum) to prevent sagging of insulation. Seal all joints with minimum 3" wide FSK Tape with identical vapor barrier facing. At the Subcontractor's option the blanket type insulation may be secured to the rectangular ducts with mechanical fasteners, such as pins and speed chip washers, on the sides and on the underside of the duct.
1. The mechanical fasteners spacing shall not exceed 12" and spaced 3" (maximum) from the butt joint. All butt joints shall have the factory lap sealed with adhesive and staples or minimum 3" wide FSK tape with identical vapor barrier facing. Longitudinal joints shall be lapped and folded and securely stapled in place. Longitudinal joint staples spacing shall not exceed 6".
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- B. Type D-2: Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Secure insulation to duct with weld pins and washers. Seal all joints (longitudinal and transverse) and weld pin penetrations with 3" wide strips of the vapor barrier jacket adhered with Foster 85-75. All outside ductwork must be waterproofed and shall be covered with 20 x 20 glass fabric sealed with two heavy coats of Foster 60-38 or Childers Encacel X vapor barrier mastic.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.

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- d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- C. Type D-3: Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
- 1. Products: Subject to compliance with requirements, non-asbestos, press molded Xonolite calcium silicate board or 6 lb. density, 1-1/2" thick lightweight, non-asbestos, high temperature inorganic ceramic fiber blanket duct wrap similar and approved equal to Nelson Fire Stop Products, Flameshield Blanket ("FSB") with Nelson Fire Stop Putty ("FSP") and other accessory products including but not limited to tapes, banding materials and insulation pins, as required for a complete system. Duct wrap shall be fire resistive enclosure system, shaft enclosure, with zero (0) clearance to combustibles when used with a listed and approved through penetration fire stop system complying with ASTM E 119, ASTM 136, ASTM E 814, UL 723, UL 1479 and UL 1978. The insulation system shall be installed in accordance with all manufacturer requirements and recommendations as well as the requirements of the applicable codes, rules, regulations and standards. Entire kitchen exhaust duct from grease removal range hood outlet collar as indicated on the drawings shall be enclosed by the insulation. Enclosure shall provide a minimum of two (2) hour fire resistive rating. Enclosure shall be constructed in accordance with the manufacturer's instructions and the Council of American Building Officials Report No. NER-332 for 0" clearance from duct enclosure to combustibles. The insulation system shall be installed in accordance with all manufacturer requirements and recommendations as well as the requirements of the applicable codes, rules, regulations and standards. Comparable products subject to compliance with the requirements by one of the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Thermal Ceramics; FireMaster Duct Wrap.
 - d. 3M; Fire Barrier Wrap Products.

2.4 EQUIPMENT INSULATION

- A. Type E-1: Mineral-Fiber Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

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- a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- B. Type E-2: Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Products: Subject to compliance with requirements, Trymer 2000 by ITW Insulation, polyisocyanurate foam pipe insulation with thermal conductivity (k factor) not exceeding $.19 \text{ (Btu} \times \text{In)} / \text{(Hr} \times \text{Ft}^2 \times \text{deg F)}$ at 75 deg F mean temperature. Insulation shall be jacketed with Saran, 560 or 520 PVDC vapor retarder tape and film with self sealing tape. ASJ paper is not acceptable. Vapor barrier mastic shall be Foster 85-20 or Childers CP-35. Adhesive for laps shall be Foster 85-75 or Childers CP-82. Pumps, Valves and Fittings shall be the fabricated trymer with 20 X 20 glass fabric sealed with Foster 80-20 vapor barrier mastic. Comparable products subject to compliance with the requirements by one of the following:
 - a. Apache Products Company.
 - b. Duna USA Inc.
 - c. Dupont.
 - d. Elliott Company.
 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed $0.19 \text{ Btu} \times \text{in./h} \times \text{sq. ft.} \times \text{deg F}$ at 75 deg F after 180 days of aging.
 3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
 4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
- C. Type E-3: Calcium Silicate:
1. Products: Subject to compliance with requirements, Hydrous calcium silicate non-asbestos insulation similar to Schuller Thermo-12 Gold. The insulation shall have an average thermal conductivity (k factor) not exceeding $0.42 \text{ (Btu} \times \text{In)} / \text{(Hr} \times \text{Ft}^2 \times \text{deg F)}$ at a mean temperature of 300 deg F. Insulation shall be finished with Ramcote 1200 or Pro-Tec-T-Kotes "V" One Coat high temperature finishing cement. All materials shall be suitable for 1200 deg F service. Comparable products subject to compliance with the requirements by one of the following:
 - a. Industrial Insulation Group (The); Thermo-12 Gold.

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2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.5 MISCELLANEOUS

- A. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; HTB 23 Spin-Glas.
 - b. Owens Corning; High Temperature Flexible Batt Insulations.
- B. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; FBX.
 - b. Johns Manville; 1000 Series Spin-Glas.
 - c. Owens Corning; High Temperature Industrial Board Insulations.
 - d. Rock Wool Manufacturing Company; Delta Board.
 - e. Roxul Inc.; Roxul RW.
 - f. Thermafiber; Thermafiber Industrial Felt.
- C. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade I for tubular materials and Type II, Grade I for sheet materials.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. RBX Corporation; Therma-cell.
- D. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall

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not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Styrofoam.
 - b. Knauf Insulation; Knauf Polystyrene.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
6. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

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7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Vimasco Corporation; Elastafab 894.
- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Chil-Glas No. 5.
- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

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1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.

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- b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 2.5-mil- thick Polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
- a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 2.5-mil- thick Polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 2.5-mil- thick Polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 SECUREMENTS

A. Bands:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

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- a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

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- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

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- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c. apply vapor-barrier mastic over staples – no exposed staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

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1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

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3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.

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9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from aluminum or stainless steel, at least 0.060 inch thick.
 3. Install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, meters, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe

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- insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. A protection saddle or shield similar to Buckaroo Insulation Saddles with galvanized finish shall be provided by the Subcontractor at each hanger or support. Pittsburgh Corning 8.5# cellular glass blocking (ASTM C552) or ICA H-Block (20 lbs./cu. ft. density) shall be installed between the pipe and the protection shield to prevent crushing of the insulation. Insulation blocking shall be not less than the same length and circumference as the pipe protection shield. The blocking material shall be finished to match adjoining pipe insulation.
- E. Install removable insulation covers at locations indicated. Installation shall conform to the following:

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1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
- F. Piping insulation exposed to weather or as specified elsewhere by the Drawings shall be covered with 0.016" thick smooth aluminum jacket (ASTM B209). Provide 1/2" wide aluminum bands applied on 12" centers. Jacket shall have a 2" overlap at each joint. Jacket seams shall be located on the bottom side of all horizontal piping.
- G. All chilled and heating hot water piping subject to freezing shall be insulated and heat traced as specified and/or as indicated by the Drawings. Provide clearance between the pipe and insulation to allow the installation of the heat trace cable. Insulation type will be as required by this Specification for each duty. All insulation, mastics, etc., shall be suitable for use with heat trace cable. Coordinate with the Electrical Subcontractor.
- H. Insulate water chillers as per manufacturer's requirements.
- I. In addition to the above requirements, insulation for chilled water piping shall comply with the following:
1. Where piping is installed outdoors in unheated garages and/or in unconditioned spaces, the insulation thickness shall be as specified herein for the ambient temperature and humidity to prevent condensation on the insulation jacket for the outdoor conditions specified.
 2. Where chilled water piping is interrupted by fittings, flanges, mechanical couplings or valves and at intervals not exceeding 26' on vertical continuous runs, and isolating seal shall be formed between the vapor barrier jacket and the bare pipe by liberal applications of Foster TITE-FIT 30-35 flexible vapor barrier joint sealant to the ends of the pipe insulation. This seal requirement is in addition to regular joint vapor seal specified hereinbefore. The seal location on vertical chilled water pipes shall be identified by an

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orange color 3/4" wide press tight tape around the circumference of the insulation. The Owner or Engineer shall select four (4) locations in the Project for the completed seal procedure to be reviewed. The seal area inspected by the Owner or Engineer shall be resealed after review and approval.

3. All system components subject to condensation must be insulated including vertical riser supports and equipment supports.
4. Control valve bodies shall be insulated and thoroughly vapor sealed where the valve actuator penetrates the insulation.
5. Insulation at chilled water ball valves shall be vapor sealed to the ball valve insulation sleeve. Utilize Saran 520 or 560 vapor retarder tape spiral wrapped.
6. Where chilled and heating hot water piping is installed in unheated garages and/or in non air conditioned spaces Type "P-2" insulation shall be installed and the insulation thickness scheduled shall be increased as required by the contractor based on the manufacturer's written recommendations for the project.

3.7 GENERAL EXHAUST AND CHIMNEY INSULATION REQUIREMENTS

- A. Diesel engine muffler, exhaust piping and breechings, metal chimneys and stacks insulation shall comply with the following:
 1. Insulation shall be composed of three (3) layers of 1-1/2" thick material for an overall thickness of 4-1/2". The joints for the first, second and third layers shall be staggered. The insulation shall be installed over spacers to provide a 1" air space between the pipe and the first layer of insulation.
 2. All protrusions through the insulation shall be wrapped and/or packed with refractory fiber. All joints and cracks over 1/8" wide shall be sealed with the specified finishing cement.
 3. Aluminum jacket shall be installed over the outer layer of insulation as specified herein for piping and metal breechings and chimneys exposed to weather.
 4. Provide expansion joints in the insulation and aluminum jacket as recommended by the manufacturer to allow for differential expansion between the exhaust pipe, insulation and jacket at the maximum operating temperature leaving the generator engine while operating at continuous full load conditions.
 5. The entire generator exhaust system from the expansion connection to the building wall or roof at the outside termination shall be insulated. The muffler shall be insulated in the same manner as specified for exhaust piping.

3.8 GENERAL REQUIREMENTS FOR INSULATION FOR EQUIPMENT (E1 and E2)

- A. Insulation shall be applied directly to the contoured surfaces of the equipment unless specified otherwise.

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- B. Insulation shall be applied to all equipment in such a manner as to allow removal of access plates, manholes, casing sections, etc., without destroying the insulation. Insulation on split case pumps shall allow removal of the upper section without destroying the insulation.
- C. Unless specifically specified herein, equipment such as water meters, automatic air vents, flow meters, backflow preventers, etc., shall be insulated as specified for the respective piping system.

3.9 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Boiler Breechings and Ducts:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

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4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.10 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

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1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.11 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

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4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.12 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

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3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

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5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface.

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Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.13 PHENOLIC INSULATION INSTALLATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

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D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.14 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

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1. Install preformed sections of polyisocyanurate insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

E. Polyisocyanurate insulation is prohibited from use in all supply and return air plenums.

3.15 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

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3.16 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.17 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

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- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

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3.18 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.19 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

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2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.21 PIPING INSULATION SCHEDULE

<u>Piping System Insulation</u>	<u>Pipe Size</u>	<u>Insulation Type</u>	<u>Thickness</u>
Chilled Water Piping (Above 42 deg F)	½" - 2"	P-1	1½"
Chilled Water Piping (Above 42 deg F)	2½" - 4"	P-1	2"
Chilled Water Piping (Below 42 deg F)	½" - 2"	P-2	1½"
Chilled Water Piping (Below 42 deg F)	2½" - 4"	P-2	1½"
Chilled Water Piping	5" - 24"	P-2	1½"
Heating Hot Water	½" - 1½"	P-1	1½"
Heating Hot Water	2" - 4"	P-1	2"
Heating Hot Water	Over 6"	P-1	2½"
Condensate Drain Piping	ALL	P-3	½"
Refrigerant Suction Piping	ALL	P-3	1"
All Engineer Exhaust Piping	ALL	P-4	4½"
Insulated Heat Traced Piping	ALL	P-1	2"

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Cooling Tower Basin Filtration Piping	ALL	P-2	1"
Condenser Water Piping on Roof	ALL	P-2	2"

3.22 DUCT INSULATION SCHEDULE, GENERAL

<u>System</u>	<u>Insulation Type</u>	<u>Minimum Insulation Thickness</u>
Outside Air Ductwork	D-1	2"
Supply Air Ductwork from Air Conditioning & Heat Pump Units	D-1	1½"
Ductwork on the discharge of VAV units, which is not internally lined	D-1	1½"
Return air ductwork located in non-conditioned spaces	D-1	1½"
Kitchen Exhaust Ductwork	D-3	2"
All Outside Air Ductwork Installed Outdoors	D-X *	2"
Plenums, General	D-X **	2"
Exposed Ductwork	D-2	See above

*Provide aluminum jacket over the board insulation sealed watertight.

**Provide waterproof foil scrim-insure exterior facing is waterproof after installation.

3.23 EQUIPMENT INSULATION SCHEDULE

<u>System</u>	<u>Insulation Type</u>	<u>Insulation Thickness</u>
Hot Water Heat Exchangers, All	E-1	2½"
Condenser Water Pumps	-	-

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Domestic Hot Water Heater	E-4	N/A
Air Accumulating Tank	E-1	1"

END OF SECTION

SECTION 230800

MECHANICAL COMMISSIONING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 RELATED DOCUMENTS

- A. The purpose of this section is to specify Division 23 responsibilities in the commissioning process.
- B. This section assumes that a Commissioning Authority (CA) is part of the project reporting directly to the Owner and is authorized to act on behalf of the Owner as called out herein. In any situation where a CA is not a part of the project, all responsibilities called to be by the CA will be performed by the Construction Manager reporting directly to the Owner.
- C. This section assumes that a Construction Manager (CM) is reporting directly to the Owner and is authorized to act on behalf of the Owner as called out herein. In any situation where a CM is not a part of the project, all responsibilities called to be by the CM will be performed by the General Contractor reporting directly to the Owner.
- D. Commissioning (Cx) requires the participation of Division 23 to ensure that all systems are operating in a manner consistent with the Contract Documents. The specific commissioning requirements will be presented in a Commissioning Plan developed by the project's Commissioning Authority (CA). Division 23 shall become familiar with all parts of the Commissioning Plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- E. This Commissioning Plan deconstructs the commissioning procedure into a series of progressive tasks that must be competed in succession to properly commission the system under review. The five stages are defined as the FACTORY TESTING, VENDOR START-UP, PREFUNCTIONAL VERIFICATION, FUNCTIONAL VERIFICATION and SYSTEM PERFORMANCE STAGES and can be described as follows:

1. The first stage is the *FACTORY TESTING* stage and it defines all the items required for the functional testing of the equipment in a factory setting. The items completed during this period will lay the foundation for the vendor start-up and functional testing of the system and the equipment within. This stage will require the manufacturer to test all equipment functions and prepare a certified factory test report prior to shipping the equipment.
2. The second stage is the *VENDOR START-UP* stage and it defines all the items required to be inspected, tested and checked for the initial start-up of the equipment. The items completed during this period will lay the foundation for the functional and acceptance testing of the system and the equipment within. This stage is an integral part of the *EQUIPMENT PREFUNCTIONAL* stage. This stage will require the cooperation of the equipment manufacturer
3. The third stage is the *EQUIPMENT PREFUNCTIONAL* stage and it defines all the items required for the installation and includes as one item, the initial start-up of the equipment. The items completed during this period will lay the foundation for the start-up and later acceptance of the system and the equipment within. This stage will require the cooperation of the commissioning agent, site personnel, and design engineer. During this stage the installing contractor and manufacturer will be required to complete the items of work on the pre-functional check list and related test forms. Through meetings with the CA, it will be determined which items on the check list are required prior to start-up and which items can follow for completion of the check list. Upon completion, including factory testing, field start-up, all tests and visual inspections, the installing contractor and manufacturer shall submit the pre-functional check list and test forms to the CA for approval. Upon receipt of approval, the functional testing can be scheduled.
4. The fourth stage consists of the *EQUIPMENT FUNCTIONAL TEST* items. The series of tests performed during this stage determines the suitability of the installed components to be placed into service and for compliance with the design and operational intent of the equipment. This stage will require the collaboration of the installing contractor with the manufacturer's representative to help assure an operational system is ready for final acceptance. During the functional testing the equipment will be subjected to all possible operating modes. The unit will then be tested to confirm that all alarm and BMS functions operate as designed. Upon completion of the alarm testing the manufacturer will prove all settings to the CA by either showing alarm set points on the control panel or simulating alarm conditions and failure modes.
5. The final stage is the *SYSTEM PERFORMANCE VERIFICATION TEST* phase, which will integrate the equipment with the other system components for final evaluation by the CA. This stage will require the installing contractor and

manufacturer's representative to operate the installed equipment for the owner's representative, CA and engineer of record's final approval.

- F. Vibration, seismic, wind & flood criteria for this vendor is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section in its entirety.
- G. VOC Limits for Adhesives, Sealants, Paints and Coatings Section 018101
- H. Construction and Demolition Waste Management Section 018102
- I. Construction Indoor Air Quality (IAQ) Management Section 018103

1.3 RESPONSIBILITIES

- A. Mechanical Contractors. The commissioning responsibilities applicable to each of the mechanical contractors of Division 23 are as follows:
 - 1. Provide startup for all HVAC, Plumbing and Fire Protection equipment.
 - 2. Assist and cooperate with the Testing and Balancing (TAB) contractor and CA by:
 - 3. Putting all equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 - 4. Including cost of sheaves, belts, and filter changes that may be required by TAB.
 - 5. Providing clearances for test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing
 - 6. Providing temperature and pressure taps according to the Construction Documents.
- B. Assist the TAB in the location and operation of all volume, control, and fire/smoke dampers.
- C. List clearly and identify on the as-built drawings the locations of all P/T plugs, airflow stations and all other such measure and verification devices.
- D. Prepare a preliminary schedule for Division 23 pipe, duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CA. Update the schedule as appropriate

- E. Notify the CM or CA depending on protocol, when pipe and duct system testing, flushing, cleaning, start up of each pipe of equipment and TAB will occur. Be responsible to notify the CM, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CA and CM both have the scheduling information needed to efficiently execute the commissioning process.
1. Lists clearly identify on the as-built drawings the locations of all P/T plugs, airflow stations and all the other such measure and verification devices.
- F. Provide the following:
1. Construction and Acceptance Phases
 2. Include and itemize the cost of commissioning in the contract price.
 3. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training
 4. Attend commissioning scoping meetings and other meetings necessary to facilitate the Cx process.
 5. Contractors shall provide the CA with normal cut sheets and shop drawing submittals of commissioned equipment.
 6. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up, pre-functional and functional testing procedures.
 - a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority.
 - b. The Commissioning Authority may request further documentation necessary for the commissioning process.
 - c. This data request may be made prior to normal submittals.

7. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review and approval.
- G. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
- H. Provide limited assistance to the CA in preparing the specific pre-functional and functional performance test procedures as outlined in the Commissioning Plan. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
- I. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists from the CA for all commissioned equipment. Submit to CA for review and approval prior to startup.
 1. During the startup and initial checkout process, execute the mechanical-related portions of the pre-functional checklists for all commissioned equipment.
 2. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
 3. Address current A/E punch list items before functional testing, air and water Testing and Balancing.
 4. Balancing (TAB) shall be completed with discrepancies and problems remedied before functional testing of the respective air-or water-related systems.
 5. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
 6. Provide skilled technicians to perform functional performance testing under the direction of the CA for specified equipment outlined in the Commissioning Plan. Assist the CA in interpreting the monitoring data, as necessary.
 7. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, CM and A/E and retest the equipment.
 8. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

9. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).
 10. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
 11. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
 12. Provide standby and assistance for specific testing requiring the coordination of multiple trades and where this contractor's equipment and systems are a part of the test or must be functioning to allow for complete performance and testing verification.
 13. Coordinate with other Division 23 contractors (additional subs and other trades) on this project and base building project as required and directed by the CM and CA.
 14. Attend Commissioning coordination meetings and provide assistance and cooperate in the preparation of a commissioning schedule with the CM and CA
 15. Commissioning Tasks shall be performed by the same personnel who were involved in the installation and are familiar with the equipment.
 16. The contractor shall include all scopes of work and costs associated / to Weehawken Guidelines identified in the Commissioning Plan.
 17. Provide training plan submittal and obtain approval prior to training.
 18. Warranty Period
 19. Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
 20. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
- J. Controls Contractor. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed under base building work are:
1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each

piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:

- a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
- b. All interactions and interlocks with other systems.
- c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BMS monitors only and what BMS points are control points and are adjustable.
- d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
- e. Start-up sequences.
- f. Warm-up mode sequences.
- g. Normal operating mode sequences.
- h. Unoccupied mode sequences.
- i. Shutdown sequences.
- j. Capacity control sequences and equipment staging.
- k. Temperature and pressure control: setbacks, setups, resets, etc.
- l. Detailed sequences for all control strategies, e.g., optimum start/stop, staging, optimization, demand limiting, etc.
- m. Effects of power or equipment failure with all standby component functions.
- n. Sequences for all alarms and emergency shut downs.
- o. Seasonal operational differences and recommendations.
- p. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
- q. Schedules, if known.

- r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.
2. Control Drawings Submittal General Requirements
 - a. The control drawings shall have a key to all abbreviations
 - b. The control drawings shall contain graphic schematic depictions of the systems and each component. Graphics shall be in color to fully distinguish between each different water system, steam, gas, etc. as well as equipment components, fan, coil, filter, etc.
 - c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - d. Provide a full points list with at least the following included for each point.
 - 1). Controlled system
 - 2). Point abbreviation
 - 3). Point description
 - 4). Display unit
 - 5). Control point or set point (Yes / No)
 - 6). Monitoring point (Yes / No)
 - 7). Intermediate Point (Yes / No)
 - 8). Calculated point (Yes / No)
 3. Key:
 4. Point Description: DB temp, airflow, etc.
 5. Control or Set Point: Point that controls equipment and can have its set point changed (OSA, SAT, etc.)
 6. Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).

7. Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
8. Calculated Point: "Virtual" point generated from calculations of other point values.
9. The Controls Contractor shall keep the CA informed of all changes to this list during programming and setup
10. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
 - a. Assist and cooperate with the TAB contractor in the following manner:
 - 1). Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting DDC controllers and other control devices and/or interfaces and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 - 2). For a given area, have all required pre-functional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CA prior to TAB.
 - 3). Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
 - 4). Assist the TAB in the location and operation of all control and fire/smoke dampers, valve actuators, static pressure controllers, thermostats, measure and verification devices, etc.
 - 5). TAB shall be responsible for the checking of the calibration of all flow measuring devices. Controls contractor shall coordinate with the TAB to validate and demonstrate proper measurements and calibration to the CA.
11. Assist and cooperate with the CA in the following manner:
 - a. Using a skilled technician, who is familiar with this building; execute the functional testing of the controls system as specified for the controls contractor in the Commissioning Plan. Assist in the functional testing of

all equipment specified in the Commissioning Plan. Provide two-way radios during the testing.

12. Execute all control system trend logs specified in the Commissioning Plan. Execute trend logs for all measured control inputs, control outputs, intervals, durations and triggers for implementing dynamic responses as described in the Cx Plan.
13. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing, according to the process in Commissioning Plan. At minimum, the plan shall include for each type of equipment controlled by the automatic controls
 - a. System name.
 - b. List of devices.
 - c. Step-by-step procedures for testing each controller after installation, including:
 - 1). Process of verifying proper hardware and wiring installation.
 - 2). Process of downloading programs to local controllers and verifying that they are addressed correctly.
 - 3). Process of performing operational checks of each controlled component.
 - 4). Plan and process for calibrating valve and damper actuators and all sensors.
 - 5). A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values
 - d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has "passed" and is operating within the contract parameters.
 - e. A description of the instrumentation required for testing.

- f. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the CA and TAB contractor for this determination.
 14. Provide a signed and dated certification to the CA and CM upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements
 15. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as specified in Section 15950, BMS and Section 15990, Testing and Balancing.
 16. Participate in mechanical and electrical coordination to both show and assure the proper installation, placement, and clearances of all control devices.
 17. List and clearly identify on the as built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).
 18. The measuring of water flow may not be done by pressure differential across, pumps, coils, terminal units, equipment components, etc. down to ½ inch pipe size and 0.5 gpm. Flow must be verified with electronic devices external to the piping.
 19. Dry test all transmitters connected to air flow measuring stations prior to balancing using an independent signal generator, impose signals in 10% increments from 0% to 120% of transducer range. Record and submit results.
- K. TAB Contractor. The duties of TAB contractor, in addition to those listed previously, as well as Specification Section 230593, Mechanical Testing are:
1. Two months prior to starting TAB, submit to the CM the qualifications of the site technician for the project, including the name of the contractors and facility managers of recent projects the technician on which was lead. The Owner will approve the site technician's qualifications for this project.
 2. Submit the outline of the TAB plan and approach for each system and component to the CA, CM and the controls contractor six (6) months prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system.
 3. The submitted plan will include:

- a. Certification that the TAB contractor has reviewed the construction documents, contractor coordination drawings and the systems with the design engineers and contractors to sufficiently understand the design for each system.
- b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
- c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
- d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
- e. Final test report forms to be used.
- f. Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch / submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the water side.
- g. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
- h. Details of how total flow will be determined (Air: sum of terminal flows via BMS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).
- i. The identification and types of measurement instruments to be used and their most recent calibration date.
- j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.
- k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.

- l. Details of whether and how minimum outside air cfm will be verified and set, and for what level (total building, zone, etc.).
 - m. Details of how building static and exhaust fan / relief damper capacity will be checked.
 - n. Proposed selection points for sound measurements and sound measurement methods.
 - o. Details of methods for making any specified coil or other system plant capacity measurements.
 - p. Details of any TAB work to be done in phases (by floor, etc.).
 - q. Details regarding specified deferred or seasonal TAB work.
 - r. Details of any specified false loading of systems to complete TAB work.
 - s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - t. Details of any required interstitial cavity differential pressure measurements and calculations.
 - u. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - v. Plan for formal progress reports (scope and frequency).
 - w. Plan for formal deficiency reports (scope, frequency and distribution).
 - x. Plan for balancing units with ECM motors.
4. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CA and CM at least twice a week.
 5. Communicate in writing to the controls contractor all set point and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.
 6. Provide a draft TAB report within two weeks of completion. A copy will be provided to the CA. The report will contain a full explanation of the

methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB or ASHRAE Standard 111.

7. Provide the CA with any requested data, gathered, but not shown on the draft reports.
8. Provide a final TAB report for the CA with details, as in the draft.
9. Conduct functional performance tests and checks on the original TAB as specified for TAB in the commissioning Plan.

1.4 RELATED WORK

- A. Submittals (including Green Bldg. Certification Form) Section 01300
- B. Construction Waste Management Section 01524
- C. Construction IAQ Management Section 01515
- D. VOC Limits for Adhesives, Sealants & Paints Section 01520
- E. Refer to the Commissioning Plan for a listing of all commissioning requirements.
- F. The Subcontractor and Vendors will be required to assist in the testing and verification of certain systems to assure the proper performance of their equipment.
- G. The project will undergo a commissioning and measurement and verification process. The Subcontractor and Vendors shall be required to sign-off on that all components and devices have been installed as per the manufacturer's recommendations and been properly calibrated prior to the CA commencing this process. Refer to the Draft

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the mechanical system and controls system in Division 15, except for equipment specific to and used

by TAB in their commissioning responsibilities. The Contractor shall review all test requirements and have on hand any devices needed so as not delay the process in the field. An example would be amperage readings shall require the Contractor to have an amp probe immediately on hand. Two-way radios shall be provided by the Division 23 Contractor.

- 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 of the Contractor and left on site, except for stand-alone data logging equipment that may be used by the CA.
- C. Data logging equipment and software required to test equipment will be provided by the BMS Contractor, and shall become the property of the Owner.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications.
- E. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.
- F. Refer to the Commissioning Plan for details regarding equipment that may be required to simulate required test conditions.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The general process of the Execution of the Commissioning Process will require the completion of the following steps / functions / procedures
 - 1. The Vendor / Manufacturer may be required to perform factory testing as described in the specific equipment documentation / specifications and provide certified factory test reports on certain pieces of equipment. Not every section of the specification will require a factory test. Where factory testing is called for, each piece of equipment must be tested unless noted otherwise.

2. The contractor with the assistance of the Vendor / Manufacturer will be required to perform a field startup test (manufacturer's startup) of specific pieces of equipment as described in the specific equipment documentation / specifications.
3. Upon completion of factory testing, submittal of factory test report(s) that is approved by the Engineer and completion of the manufacturer's field start up test, the vendor can complete the pre-functional checks as identified in the Commissioning Plan.
4. The CA will meet with the Contractor to develop proper test procedures and observe each Contractor performing the initial test of one Pre-functional Check of a specific piece of equipment or testing process. Once one check is administered, the contractor / vendor will be responsible for completing the remainder of the similar checks under the supervision of the CM. The Contractor shall be responsible for completing the forms electronically and submitting them to the CA for review and approval.
5. Upon submission of pre-functional testing and approval of pre-functional testing forms by the CA, the vendor can then schedule the functional testing of the equipment that will be witnessed at a minimum by the CA and CM.
6. The CA will observe and administer each Functional Test of each piece of equipment and will document the results of the test.
7. Upon successful completion of the functional system test and sign-off from all parties involved the vendor can schedule any training sessions with site personnel that may be required.
8. If a Systems Integration test is required for a particular piece of equipment, the additional tests will be scheduled by the CA & CM.
9. See the Commissioning Plan for additional information.

3.2 SUBMITTALS

- A. During the progress of the Work, tests shall be made as specified herein and as required by authorities having jurisdiction, including local authorities Inspection Department, Owner, Owner's Insuring Agency, Architect or Engineer. Tests shall be conducted by the HVAC, Plumbing and Fire Protection Subcontractor as part of the Work of this Division and shall include all qualified personnel, equipment apparatus and services required to perform the tests.

3.3 STARTUP

- A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in the Commissioning Plan. Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and pre-functional and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Authority, CM or Owner
- B. Functional Testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA and Owner. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all pre-functional checklists as soon as possible.

3.4 TAB

- A. Refer to the TAB responsibilities in Part 1.2 above.

3.5 PRE-FUNCTIONAL AND FUNCTIONAL PERFORMANCE TESTS

- A. The following is the scope for commissioning specific types of equipment: Refer to sample Cx forms.
 - 1. Terminal Units, Exhaust Fans and Smoke Purge Fans:
 - a. 20% of terminal units including High Rise Heat Pumps, VAV and CAV boxes and 100% of water cooled a/c units over 5 tons, Smoke Purge Fans and Exhaust Fans will be commissioned. If any terminal unit fails an additional 20% will be tested, if any additional fail, all will be tested.
 - b. Measure amps and volts of motors at full load conditions.
 - c. Verify local control ramps motor speed of variable speed motors up and down properly.
 - d. Verify all actuators modulate full range of required motion accurately.
 - e. Verify all sensors are calibrated and reading accurately locally and at front end BMS workstation.

- f. Verify all control sequences and alarms work per design locally and from front end BMS workstation.
 - g. Verify all interactions with building fire alarm system work as required by design.
 - h. Verify all BMS programming and graphics, as pertaining to this equipment, are complete from front end BMS workstation.
2. 20% of finned tube radiators will be commissioned for proper modulation and control, including control interlock to terminal units where applicable. If any finned tube radiator control fails an additional 20% will be tested, if any additional fail, all will be tested.
3. Domestic Hot Water Recirc Pumps, Sewage Sectors, Sump Pumps
 - a. Measure amps and volts of motors at full load conditions.
 - b. Verify all sensors are calibrated and reading accurately locally and at front end BMS workstation.
 - c. Verify all control sequences and alarms work per design locally and from front end BMS workstation.
 - d. Verify all BMS programming and graphics, as pertaining to this equipment, are complete from front end BMS workstation.
4. Boilers (B1, B2, B3, B4)
 - a. Verify all sensors are calibrated and reading accurately, locally and at front end BMS workstation.
 - b. Verify all control sequences and alarms work per design locally and from front end BMS workstation.
 - c. Verify all BMS programming and graphics, as pertaining to this equipment, are complete from front end BMS workstation.
5. Dry Pipe System Testing
 - a. Test all panel specific alarms
 - b. Perform water flow alarm test
 - c. Perform low air alarm test

d. Perform partial operational trip test (without water flow)

B. Pre-functional Checklist (PC) - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CA to the Sub. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word pre-functional refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the pre-functional checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning authority only requires that the procedures be documented in writing, and does not witness much of the pre-functional check listing, except for larger or more critical pieces of equipment.

C. Functional Performance Test (FT) - 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 set point). 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 (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. Functional Tests are performed after pre-functional checklists and startup is complete.

3.6 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. Documentation. The CA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the Subs for review. The Subs will include the filled out forms in the O&M manuals.

- B. Non-Conformance.
1. The CA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the CM on a standard non-compliance form.
 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. In such cases the deficiency and resolution will be documented on the procedure form.
 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owner.
 4. As tests progress and a deficiency is identified, the CA discusses the issue with the executing contractor.
 - a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it.
- C. The CA documents the deficiency and the Sub's response and Intentions and they go on to another test or sequence. After the day's work, the CA submits the non-compliance reports to the CM for signature, if required. A copy is provided to the Sub and CA. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CA.
- D. The CA reschedules the test and the test is repeated.
- E. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible.
- F. The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the CM and to the Sub representative assumed to be responsible.
- G. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner.
- H. The CA documents the resolution process.

- I. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CA. The CA reschedules the test and the test is repeated until satisfactory performance is achieved.
- J. Cost of Retesting.
 1. The cost for the Sub to retest a pre-functional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the CM.
 2. For a deficiency identified, not related to any pre-functional checklist or start-up fault, the following shall apply: The CA and CM will direct the retesting of the equipment once at no "charge" to the Subcontractor for their time. However, the CA's and CM's time for a second retest will be charged to the Subcontractor.
 3. The time for the CA and CM to direct any retesting required because a specific pre-functional checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the Subcontractor for executing the faulty pre-functional test.
 4. Refer to the Commissioning Plan for requirements for testing and retesting identical equipment.
 5. The Contractor shall respond in writing to the CA and CM at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 6. The CA retains the original non-conformance forms until the end of the project.
 7. 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.
- K. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CM. In such case, the Contractor shall provide the Owner with the following:
 1. Within one week of notification from the CM, the Contractor or manufacturer's representative shall begin examining all other identical units until a representative number of units, as determined by the Engineer, are examined

sufficient to determine the extent and cause of the failure. The findings shall be recorded and provided to the CM within two weeks of the original notice.

2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
3. The CM will determine whether a replacement of all identical units or a repair is acceptable.
4. Two examples of the proposed solution will be installed by the Contractor and the CM will be allowed to test the installations for up to one week, upon which the CM will decide whether to accept the solution.
5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

- L. Approval. The CA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CA and by the CM, if necessary. The CA recommends acceptance of each test to the CM using a standard form. The CM gives final approval on each test using the same form, providing a signed copy to the CA and the Contractor.

3.7 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. Contractors shall comply with the requirements of specification Section 230500 regarding O&M Manuals.

3.8 TRAINING OF OWNER PERSONNEL

- A. Construction Manager -The CM shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 230500 for additional details.
- B. Commissioning Authority -The CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 230500 for additional details.

- C. Mechanical Contractor -The mechanical contractor shall perform training utilizing both classroom instruction and field demonstrations. Refer to section 230500 for additional details.
- D. Controls Contractor -The controls contractor shall perform training utilizing on and off-site classroom instruction and field demonstrations. Refer to Section 230500 and 230900 for additional details.
- E. Testing and Balancing Contractor -The TAB contractor shall perform training on the results of TAB reports and measuring techniques. Refer to Section 230500 or 230593 for additional details.

3.9 DEFERRED TESTING

- A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.
- B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system’s design) specified in Commissioning Plan shall be completed as part of this contract. The CA and CM shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CA witnessing. Any final adjustments to the O&M manuals and as-builts due to the testing will be made.

3.10 WRITTEN WORK PRODUCTS

- A. The commissioning process generates a number of written work products described in various parts of the Specifications. The Commissioning Plan shall list all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

<u>Product</u>	<u>Developed By</u>
Final Commissioning plan	CA
Commissioning Meeting Minutes	CA
Commissioning schedules	CM with subs
Pre-functional Test Procedures	CA
Sequence clarifications	A/E with subs

Pre-functional checklist verification	CM with subs
Startup and initial checkout	subs and CM
(Compilation of existing documents)	
Forms filled out	subs and CM
Final TAB report	TAB
Punchlist	A/E and CM
Commissioning progress record	CA
Deficiency reports (not punch list)	CA and CM
Functional test forms	CA and CM
Filled out functional tests	CA and Subs
O&M Manuals	CA and Subs
Commissioning record book	CA
Overall training plan	CA and CM
Specific /training agendas	Subs
Final commissioning report	CA
Misc. approvals	CA

END OF SECTION

February 15, 2023

SECTION 230900

CONTROLS FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Building Controllers and Advanced Application Controllers shall be selected to provide a minimum of 15% spare I/O point/object capacity for each point/object type found at each location. If input /objects are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point/object used.
- B. General: The control system shall be as described and consist of a high-speed, peer-to-peer network of DDC controllers and server residing in the cellar and communicating of a BACnet IP (Internet Protocol). The server shall be a Personal Computer (PC) with a color monitor, mouse, keyboard, and printer. The pc will allow a user to interface with the network via multi-tasking dynamic color graphics. Each mechanical system, building floor plan, and control device will be depicted by point-and-click graphics. Systems using gateways to route proprietary devices and objects to BACnet are not acceptable.
- C. For Local Area Network installations provide access to the control system via the Internet. The owner shall provide a connection to the internet through the facility ISP. The owner shall pay for all monthly internet access fees and connection charges.
- D. The control system shall be supplied with a complete browser enabled package. The system shall support unlimited users using standard browser browsers such as internet explorer and chrome. Browser software shall be manufactured by the control system manufacturer and shall have the same look and feel as the operating system. Third party browser software is not acceptable.
- E. System object capacity. The system size shall be expandable to at least twice the number of input/output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement.
- F. Provide a separate controller for each AHU or other HVAC system.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 01 specification sections, apply to this section.

1.3 SUMMARY

- A. Section Includes:
 - 1. DDC System for monitoring and controlling of HVAC and lighting systems.
 - 2. Delivery of selected control devices to equipment and systems' manufacturers for factory installation and to HVAC systems' installers for field installation.
- B. Section Includes:

1. Section 230993 "Sequence of Operations for HVAC DDC" for control sequences in DDC systems.
2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables".
3. Section 260533 "Raceways and Boxes for Electrical Systems" for raceways for low-voltage control cable.
4. Section 260553 "Identification for Electrical Systems" for identification requirements for electrical components.

1.4 DEFINITIONS AND ABBREVIATIONS

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.
- B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
- C. ANSI: American National Standards Institute
- D. ASCII: American Standard Code for Information Interchange
- E. AWG: American Wire Gauge
- F. BACnet Specific Definitions:
 1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
 2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
 3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
 4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
 5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.
- G. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.
- H. BMS: Building Management System
- I. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.
- J. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.
- K. COV: Changes of Value
- L. CPU: Central Processing Unit

- M. DAC: Digital to Analog Converter
- N. DDC: Direct Digital Control
- O. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system work indicated.
- P. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.
- Q. DOCSIS: Data-Over Cable Service Interface Specifications
- R. EEPROM: Electronically Erasable Programmable Read Only Memory
- S. EMI: Electromagnetic Interference
- T. E/P: Voltage to Pneumatic
- U. FAS: Fire Alarm Detection and Annunciation System
- V. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.
- W. HLC: Heavy Load Conditions
- X. HOA: Hand-Off-Auto
- Y. IEEE: Institute of Electrical and Electronics Engineers
- Z. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.
- AA. I/P: Current to Pneumatic
- BB. LAN: Local Area Network
- CC. LCD: Liquid Crystal Display
- DD. LED: Light Emitting Diode
- EE. Low-Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- FF. MCC: Motor Control Center
- GG. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.

- HH. Modbus TCP/IP: An open protocol for exchange of process data.
- II. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.
- JJ. MTBF: Mean time between failures
- KK. NC: Normally Closed
- LL. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers that communicate on peer-to-peer network for transmission of global data.
- MM. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.
- NN. NO: Normally Open
- OO. OAT: Outdoor Air Temperature
- PP. ODBC: Open Database Connectivity
- QQ. OWS: Operator Workstation
- RR. PC: Personal Computer
- SS. POT: Portable Operator's Terminal
- TT. PUE: Performance Usage Effectiveness
- UU. RAM: Random Access Memory
- VV. RF: Radio Frequency
- WW. RFI: Radio Frequency Interference
- XX. RH: Relative Humidity
- YY. ROM: Read Only Memory
- ZZ. Router: Device connecting two or more networks at network layer.
- AAA. RTD: Resistance Temperature Detector
- BBB. Server: Computer used to maintain system configuration, historical and programming database.
- CCC. UPS: Uninterruptible Power Supply
- DDD. USB: Universal Serial Bus
- EEE. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

FFF. VAC: Volts, Alternating Current

GGG. VAV: Variable Air Volume

HHH. VDC: Volts, Direct Current

III. WAN: Wide Area Network

JJJ. WLED: White Light Emitting Diode.

1.5 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

A. Andover Controls

1.6 QUALITY ASSURANCE

A. Contractor/Manufacturer Qualifications

1. The installer shall have an established working relationship with the control system manufacturer, and be the authorized representative of the manufacturer at bid time.
2. The installer shall have successfully completed control system manufacturer's classes on the control system. The installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
3. All products used in this installation shall be new, currently under manufacture, and shall be applied in standard off the shelf products. This installation shall not be used as a test site for any new products unless explicitly approved by the engineer in writing. Spare parts shall be available for at least 5 years after completion of this contract.

1.7 CODES AND STANDARDS

A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:

1. AABC – Associated Air Balance Controls
2. ADC – Air Diffuser Council
3. AMCA – Air Moving and Conditioning Association
4. ANSI – American National Standards Institute
5. ARI – Air-conditioning Refrigeration Institute
6. ASHRAE 135-2004
7. ASME – American Society of Mechanical Engineers
8. ASTM – American Society for Testing and Materials

9. FCC Regulation, Part 15- Governing Frequency Electromagnetic Interference
10. National Electric Code (NEC)
11. NEMA – National Electrical Manufacturers' Association
12. New York City Building Code
13. New York City Mechanical Code
14. NFPA – National Fire Protection Association
15. OSHA – Occupational Safety and Health Administration Regulations
16. Underwriters Laboratories UL916

1.8 EXPOSED DEVICES

- A. All devices visible, e.g., wall-mounted sensors or switches, ceiling-mounted sensors, outdoor air sensors, enclosures, air pressure ports, etc. to the public must be submitted in sample form, for approval. No visible equipment shall be considered approved for construction unless it has received a written approval letter stating that the sample is approved for installation.

1.9 SYSTEM PERFORMANCE

- A. Performance Standards. The system shall conform to the following:
 1. Graphic Display. The system shall display a graphic with 20 dynamic points/objects with all current data within 10 seconds.
 2. Graphic Refresh. The system shall update a graphic with 20 dynamic points/objects with all current data within 8 seconds.
 3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be less than 2 seconds. Analog objects should start to adjust within 2 seconds.
 4. Object Scan. All changes of state and change of analog values will be transmitted over the high-speed Ethernet network such that any data used or displayed at a controller or workstation will have been current within the previous 2 seconds.
 5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the server shall not exceed 45 seconds.
 6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 1 second. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
 7. Performance. Programmable controllers shall be able to execute DDC PID control loops at a frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.

8. Reporting Accuracy. The system shall report all values with an end-to-end accuracy as listed or better than those listed in Table 1.
9. Stability of Control. Control loops shall maintain measured variable at set point within the tolerances listed in Table 2.

B. TABLE 1: Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C [±1°F]
Ducted Air	±0.5°C [±1°F]
Outside Air	±1.0°C [±2°F]
Dewpoint	±1.5°C [±3°F]
Water Temperature	±0.5°C [±1°F]
Delta-T	±0.15°C [±0.25°F]
Relative Humidity	±5% RH
Water Flow	±5% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Air Pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air Pressure (space)	±3 Pa [±0.01 "W.G.]
Air Pressure (smoke control)	0.25% full scale
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power factor)	5% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm
Note 1: 10%-100% of scale	
Note 2: For both absolute and differential pressure	
Note 3: Not including utility-supplied meters	

C. TABLE 2: Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa [±0.2" w.g.] ±3 Pa [±0.01" w.g.]	0-1.5 kPa [0-6" w.g.] -25 to 25 Pa [-0.1 to 0.1" w.g.]
Airflow	±10% of full scale	
Temperature	±0.5°C [±1.0°F]	
Humidity	±5% RH	
Fluid Pressure	±10 kPa [±1.5 psi]	0-1 kPa [1-150 psi]

Controlled Variable	Control Accuracy	Range of Medium
Differential	± 250 Pa [± 1.0 " w.g.]	0-12.5 kPa [0-50"w.g.]

1.10 SUBMITTALS

- A. Product Data and Shop Drawings: Contractor shall provide shop drawings or other submittals on all hardware, software, and installation to be provided. No work may begin on any segment of this project until submittals have been reviewed and approved for conformity with the design intent. Three copies are required. All drawings shall be done in DXF format and provided on magnetic/optical disk and as full-size Mylar drawings. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall be provided within 12 weeks of contract award. Submittals shall include:

1. Direct Digital Control System Hardware:

- a. A complete bill of materials of equipment to be used shall be listed indicating quantity, manufacturer, model number, and other relevant technical data.
- b. Manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for the items listed below and other relevant items not listed below:
 - 1) Direct Digital Controller (Controller Panels)
 - 2) Direct Digital Controller (Rated UL864 and Its Entire Network)
 - 3) Transducers/Transmitters
 - 4) Sensors (Including Accuracy Data)
 - 5) Actuators
 - 6) Valves
 - 7) Relays/Switches
 - 8) Control Panels
 - 9) Power Supply
 - 10) Batteries
 - 11) Server Equipment
 - 12) Wiring
- c. Wiring diagrams and layouts for each control panel. Show all termination numbers.
- d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware.

2. Central System Hardware and Software

- a. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and other relevant technical data.
- b. Manufacturer's description and technical data, such as product specification sheets and installation/maintenance instructions for the items listed below and other relevant items not listed below:
 - 1) Server

- 2) Monitors
 - 3) Printers
 - 4) Keyboard
 - 5) Power Supply
 - 6) Battery Backup
 - 7) Interface Equipment between CPU and Control Panels
 - 8) Operating System Software
 - 9) Color Graphic Software
 - 10) Third-party Software
- c. A schematic diagram for all control wiring, communication wiring and power wiring shall be provided. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers, function and data link protocol(s). Show all interface wiring to the control system
- d. Provide detailed riser diagrams of wiring between central control unit, server, routers, gateways and all control panels
- e. A list of the color graphic screens shall be provided. For each screen, provide a conceptual layout of pictures and data, and show or explain which other screens can be directly accessed.
3. Controlled Systems:
- a. A schematic diagram of each controlled system. The schematics shall have all control points/objects labeled and with point/object names shown or listed. The schematics shall graphically show the location of all control elements in the system.
 - b. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, it shall be labeled with the same name. All terminals shall be labeled.
 - c. An instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.
 - d. A mounting, wiring, and routing plan view drawing. The drawing shall be done in 1/4" scale. The design shall take into account HVAC, electrical and other systems' design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
 - e. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
 - f. A point/object list for each system controller including inputs and outputs (I/O), point/object number, the controlled device associated with the I/O point/object, and the location of the I/O device. Software flag points/objects, alarm points/objects, etc.
4. Quantities of items submitted shall be reviewed, but are the responsibility of the Contractor.
5. A description of the proposed process along with all report formats and checklists to be used in Part 3: "Control System Demonstration and Acceptance."
6. A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and Server included in the submittal. PICS to include for each product, as a minimum, a list of BACnet functional groups supported, BACnet services supported, BACnet data link options available and BACnet objects provided.

B. Schedules:

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1. Within one month of contract award, provide a schedule of the work indicating the following:
 - a. Intended sequence of work items.
 - b. Start dates of individual work items.
 - c. Duration of individual work items.
 - d. Planned delivery dates for major material and equipment, and expected lead times.
 - e. Milestones indicating possible restraints on work by other trades or situations.
 2. Provide monthly written status reports indicating work completed, revisions to the expected delivery dates, etc. An updated project schedule shall be included.
- C. Project Record Documents: Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include:
1. Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of magnetic media including DXF drawing files also shall be provided
 2. Testing and Commissioning Reports and Checklists. Completed versions of all reports and checklists, along with all trend logs, used to meet the requirements of Part 3: "Control System Demonstration and Acceptance."
 3. Certification of the pressure test required in Part 3: "Control Air Tubing."
 4. Operation and Maintenance (O & M) Manual. This shall include as-built versions of the submittal product data. In addition to the information required for submittals, the O & M manual shall include:
 - a. Names, addresses, and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representatives of each.
 - b. Operators Manual with procedures for operating the control systems, including logging on/off, alarm handling, producing point/object reports, trending data, overriding computer control, and changing set points and other variables.
 - c. One set of Programming Manuals with a description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point/object database creation and modification, program creation and modification, and use of the editor.
 - d. Engineering, Installation, and Maintenance Manual(s) that explain how to design and install new points/objects, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
 - e. A listing and documentation of all custom software created using the programming language, including the set points, tuning parameters, and object database. One set of magnetic/optical media containing files of the software and database also shall be provided.
 - f. One set of magnetic/optical media containing files of all color graphic screens created for the project.
 - g. A list of recommended spare parts with part numbers and suppliers.
 - h. Complete original issue documentation, installation, and maintenance information for all third-party hardware provided, including computer equipment and sensors.
 - i. Complete original issue diskettes for all software provided, including operating systems, programming language, and graphics software.
 - j. Licenses, guarantee, and warranty documents for all equipment and systems.
 - k. Recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

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- D. Training Manuals: The Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Engineer may modify any or all of the training course outline and training materials to meet the needs of the Owner. Review and approval by the Engineer shall be completed at least three weeks prior to the first class.

1.11 FIRST YEAR SERVICE

- A. First year callbacks for calibration and adjustments as directed by Owner/Engineer.

1.12 WARRANTY

- A. Warrant all work as follows:

1. Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.
2. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period.
3. At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Engineer, the Engineer shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty.
4. Server software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the Contractor shall be provided at no charge during the warranty period. Any upgrades or functional enhancements associated with the above mentioned items also can be provided during the warranty period for an additional charge to the Owner by purchasing an in-warranty technical support agreement from the Contractor. Written authorization by the Owner must, however, be granted prior to the installation of any of the above-mentioned items.
5. Exception: The Contractor shall not be required to warrant reused devices, except for those that have been rebuilt and/or repaired. The Contractor shall warrant all installation labor and materials, however, and shall demonstrate that all reused devices are in operable condition at the time of Engineer's acceptance.

1.13 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project-developed software and documentation shall become the property of the Owner. These include, but are not limited to:
 1. Project graphic images
 2. Record drawings
 3. Project database
 4. Project-specific application programming code
 5. All documentation

PART 2 - PRODUCTS

2.1 SECTION INCLUDES

- A. Materials
- B. Communication
- C. Server
- D. Controller Software
- E. Building Controllers
- F. Advanced Application Controllers
- G. Application Specific Controllers
- H. Input/ Output Interface
- I. Power Supplies and Line Filtering
- J. Auxiliary Control Devices
- K. Wiring and Raceways

2.2 MATERIALS

- A. All products used in this project installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's Representative in writing. Spare parts shall be available for at least five years after completion of this contract.

2.3 COMMUNICATION

- A. All control products provided for this project shall comprise a BACnet internetwork. Communication involving control components shall conform to ANSI/ASHRAE Standard 135-2004, BACnet.
- B. Each BACnet device shall operate on the BACnet Data Link/Physical layer protocol specified for that device as defined in this section.
- C. The Contractor shall provide all communication media, connectors, repeaters, bridges, hubs, switches, and routers necessary for the internetwork.
- D. All controllers shall have a communication port for Inter-connections using the BACnet Data Link/Physical layer protocol.
- E. Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:

1. Connection of an Operator Workstation device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
 2. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to an object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform internetwork value passing.
- F. The time clocks in all controllers shall be automatically synchronized daily. An operator change to the time clock in any controller shall be automatically broadcast to all controllers on the network.
- G. The network shall have the following minimum capacity for future expansion:
1. Each Building Controller shall have routing capacity for 99 controllers.
 2. The Building Controller network shall have capacity for 1000 Building Controllers.
 3. The system shall have an overall capacity for 12,500 Building Controller, Advanced Application Controller, and Application Specific Controller input/output objects.

2.4 SERVER

- A. Server. Equipment needs to be provided with UPS power to allow seamless transition to emergency power.
- B. Server. Furnish one PC-based server. Server shall be able to access all information in the system. They shall reside on the same Ethernet Protocol Network as the Building Controllers.
- C. Server information access shall use the BACnet protocol. Communication shall use the ISO 8802-3 (Ethernet) Data Link/Physical Layer Protocol. The server shall be BTL listed as a server B-AWS at the time of bid.
- D. Hardware. The server shall consist of the following:
1. The CPU shall be a minimum of an Intel® Core™ i5 based computer (minimum processing speed of 2.8 GHz with 4 GB RAM, CD/DVD RW drive and a 80GB hard disk with a minimum access time of 12 milliseconds shall be provided. A two-button mouse also will be provided. Furnish all required serial, and network communication ports, and all cables for proper system operation. The PC shall have a minimum of a 21" LCD monitor with minimum 1280 x 1024 resolution.
 2. Printers. Provide one printer equivalent to a HPM277DW and associated cables for one laser printer.
 3. BACnet Interoperability Building Blocks. The server shall support the following BIBBs:

DATA SHARING	ALARM & EVENT	SCHEDULING	TRENDING	DEVICE MGMT.	NETWORK MGMT
DS-RP-A,B	AE-N-A	SCHED-A	T-V-A	DM-DDB-A,B	NM-CE-A
DS-RPM-A,B	AE-N-I-B	SCHED-I-B	T-VMT-A	DM-DOB-A,B	NM-CEB
DS-WP-A,B	AE-N-E-B	SCHED-E-B	T-VMT-I-B	DM-DCC-A,B	

DATA SHARING	ALARM & EVENT	SCHEDULING	TRENDING	DEVICE MGMT.	NETWORK MGMT
DS-WPM-A,B	AE-ACK-A,B	SCH-VM-A	T-VMT-E-B	DM-PT-A,B	
DS-COV-A,B	AE-ASUM-A,B	SCH-AVM-A	T-ATR-A	DM-TM-B	
DS-COVU-A,B	AE-ESUM-A,B	SCH-WS-A	T-ATR-B	DM-TS-A	
DS-V-A	AE-INFO-A,B	SCH-WS-I-B	T-A-A	DM-ATS-A	
DS-AV-A	AE-VN-A			DM-MTS-A	
DS-M-A	AE-AVN-A			DM-UTC-A,B	
DS-AM-A	AE-VM-A			DM-RD-A	
	AE-AVM-A			DM-BR-A	
	AE-AS-A			DM-LM-A,B	
				DM-OCD-A,B	
				DM-ANM-A	
				DM-ADM-A	

E. System Software

1. Operating System. Furnish a concurrent multi-tasking operating system. The operating system also shall support the use of other common software applications that operate under Microsoft Windows. Examples include Lotus 123, Microsoft Excel, AutoCAD Revit, Microsoft Word, and Microsoft Access. Acceptable operating systems are Windows XP Pro and Windows7.
2. System Graphics. The software shall be a graphical user interface (GUI). The system shall allow display of up to 10 dynamic and animated graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while on-line. An operator with the proper password level shall be able to add, delete, or change dynamic objects on a graphic. Dynamic objects shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the object.
3. Custom Graphics. Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics. The graphics generation package also shall provide the capability of capturing or converting graphics from other programs such as Visio or AutoCAD
4. Graphics Library. Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program. Graphics shall be created by drag-and-drop selection of graphic symbols and drag-and-link with BACnet objects with dynamic and interactive display fields.

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5. Multilingual. Software shall be supported in the following languages English, Spanish, French, German, and Chinese.
 6. Dynamic Data Exchange (DDE). Software shall support dynamic data sharing with other Windows-based programs for third party add-on functionality e.g. preventative maintenance, tenant billing, etc.
- F. System Applications. The server shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation:
1. System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each Building Controller. This database shall be updated whenever an operator initiates a save command.
 2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to save the database from any system panel. The operator shall be able to clear a panel database via the network and may initiate a download of a specified database to any panel in the system from the network.
 3. System Configuration. The server software shall provide a method of configuring the system. This shall allow for future system changes or additions by users under proper password protection.
 4. On-Line Help. Provide a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
 5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the functions accessible to viewing and/or changing each system application.
 6. System Diagnostics. The system shall automatically monitor the operation of the server, printers, network connections, building management panels, and controllers.
 7. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, alarm limit differentials, states, and reactions for each object in the system.
 8. Alarm Messages. Alarm messages shall use the English language descriptor for the object in alarm, in such a way that the operator will be able to recognize the source, location, and nature of the alarm without relying upon acronyms or other mnemonics.
 9. Alarm Reactions. The operator shall be able to determine (by object) what if any actions are to be taken during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation.
 10. Trend Logs. The operator shall be able to define a custom trend log for any data object in the system. This definition shall include change-of-value digital, change-of-value analog, time interval, start time, and stop time. Trend data shall be sampled and stored on the Building Controller panel, and be archivable on the hard disk and be retrievable for use in spreadsheets and standard database programs.
 11. Alarm and Event Log. The operator shall be able to view all system alarms and change of states from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms.
 12. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system. The status shall be available by menu, on graphics, or through custom programs.
 13. Clock Synchronization. The real-time clocks in all building control panels shall be using the BACnet Time Synchronization service. The system also shall be able to automatically synchronize all system clocks daily from any operator-designated device in the system. The system shall automatically adjust for daylight savings and standard time, if applicable.

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- G. Applications Editors. The server shall support editing of all system applications. The applications shall be downloaded and executed at one or more of the controller panels.
1. Controller. Provide a full-screen editor for each type of application that shall allow the operator to view and change the configuration, name, control parameters, and set points for all controllers.
 2. Scheduling.
 - a. An editor for the scheduling application shall be provided. Provide a method of selecting the desired schedule and month. This shall consist of a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The start and stop times for each object shall be adjustable from this master schedule.
 - b. Event Scheduling must be supported. Operator shall be able to schedule an event by specific date, date range, or repetitive pattern (like, first Monday of the month, December 25th forever, Weekdays). Operator shall be able to schedule equipment "on" or "off" as well as schedule set point changes (analog events) on the calendar.
 3. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. The programming language shall have the following features:
 - a. The language shall be English language oriented, be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and allow for free-form programming (i.e., not column-oriented or "fill in the blanks").
 - b. A full-screen character editor/programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete custom programming code. It also shall incorporate word processing features such as cut/paste and find/replace.
 - c. The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
 - d. The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and observe any intermediate values and/or results. The debugger also shall provide error messages for syntax and execution errors.
 - e. The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - f. The programming language shall support floating point arithmetic using the following operators: +, -, /, x, square root, and x-to-the-y-power. The following mathematical functions also shall be provided: natural log, log, trigonometric functions (sine, cosine, etc.), absolute value, and minimum/maximum value from a list of values.
 - g. The programming language shall have predefined variables that represent time of day, day of the week, month of the year, and the date. Other predefined variables shall provide elapsed time in seconds, minutes, hours, and days. These elapsed time variables shall be able to be reset by the language so that interval-timing functions can be stopped and started within a program. Values from all of the above variables shall be readable by the language so that they can be used in a program for such purposes as IF/THEN comparisons, calculations, etc.
 - h. The language shall be able to read the values of the variables and use them in programming statement logic, comparisons, and calculations.

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- i. The programs shall support online changes with the ability to read real time values without exiting the program. Sample programs and syntax help functions shall be resident in the program.

H. Report Management

1. The following reporting capability shall be provided.
 - a. Reporting:
 - 1) Internal reports built into the server software
 - 2) External reporting via Open Database Connectivity (ODBC)
 - b. Internal Reports
 - 1) User definable query reports (support advanced multiple property, multiple object).
 - 2) Reports shall be scheduled for automatic generation by schedule or event.
 - 3) Manual execution to printing/file.
 - 4) Ability to save report in system report folder.
 - 5) Query controller hierarchy.
 - 6) Report to multiple destinations:
 - (a) Email
 - (b) Print
 - (c) File (.text, .csv, .xml)
 - (d) Terminal
 - c. Enterprise Interface
 - 1) ODBC driver supporting common SQL statements (select, update, insert, where, order by, group by, etc.)
 - 2) Allow integration to Enterprise software
 - 3) Shall be capable of being used with third party software that supports ODBC connection such as: Microsoft Access, Excel, Crystal Reports, etc.
 - 4) All queries shall be real time into live controller network.
 - 5) Shall be able to both read and write using SQL.

2.5 CONTROLLER SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and operate in the system controllers.
- B. System Security
 1. User access shall be secured using individual security passwords and user names.
 2. Passwords shall restrict the user to the site, objects, applications, and system functions as assigned by the system manager.
 3. User Log On/Log Off attempts shall be recorded.
- C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each schedule shall consist of the following:

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1. Provide an event scheduling system that allows the operator to specify a single event, multiple day event and/or recurring events. The event schedule specifies both the on/off times and the date in a calendar planning format similar to Microsoft Outlook®.
 2. Calendar Schedules. Provide the capability for the operator to define up to 99 special schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each calendar period.
- D. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm.
- E. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user-designated run-time, starts, and/or calendar date limits.
- F. Sequencing. Provide application software to properly sequence the start and stop of chillers, boilers, and pumps to minimize energy usage in the facility.
- G. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-windup shall be supplied. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, set point, and PID gains shall be user-selectable.
- H. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage.
- I. Energy Calculations. Provide software to allow instantaneous power (e.g., kW) or flow rates (e.g., L/s [GPM]) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window kW demand value.
- J. Anti-Short Cycling. All binary output objects shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.
- K. On/Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and set point. The algorithm shall be direct-acting or reverse-acting, and incorporate an adjustable differential.
- L. Run-time Totalization. Provide software to totalize run-times for all binary input objects. A high run-time alarm shall be assigned, if required, by the operator.

2.6 BUILDING CONTROLLERS

- A. General. Provide an adequate number of BACnet® Building Controllers to achieve the performance specified in the Part 1 Article on "System Performance." Each of these panels shall meet the following requirements. Additionally, provide Building Controllers where shown on the drawings.
1. The Energy Management and Control System shall be comprised of one or more independent, standalone, microprocessor-based Building Controllers to manage the global strategies described in the System Software section.
 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 3. Data shall be shared between networked Building Controllers.

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4. The operating system of the Building Controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information, and allow central monitoring and alarms.
5. Controllers that perform scheduling shall have a battery or super-cap backed up real-time clock.

B. Communication

1. Each Building Controller shall support direct Ethernet or a communications card. The Building Controller shall be connected to the BACnet network using the ISO 8802-3 (Ethernet) Data Link/ Physical layer protocol, or BACnet IP (Annex J).
2. Each Building Controller with a communications card shall perform BACnet routing if connected to a network of Custom Application and Application Specific Controllers.
3. The controller shall provide a service communication port using BACnet Data Link/ Physical layer protocol P-T-P for connection to a hand-held workstation/ and/or modem.
4. The Building Controller secondary communication network shall support BACnet MS/TP.

C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at 0°C to 40°C [32°F to 100°F] and 10 to 90% RH.
2. Controllers used in conditioned space shall be mounted in dust-proof enclosures, and shall be rated for operation at 0°C to 50°C [32°F to 120°F].

D. Building Controllers shall be fully peer to peer.

E. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field- removable, modular terminal strips — or to a termination card connected by a ribbon cable.

F. Memory. The Building Controller shall have as a minimum standard SRAM of 256 KB, standard DRAM of 1MB and standard non-volatile 1 MB of flash memory in lieu of EPROM. Memory shall be user extendible through RAM chip sockets and SIMMs for future memory expansion.

G. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. The Building Controller shall maintain all database information including BIOS and programming information in the event of a power loss for at least 72 hours. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m [3 ft].

H. Inputs/Outputs.

1. Inputs. Controller input/output board shall support dry contact, 0-5 VDC and 0-10 VDC-voltage, 4-20 mA- current and thermistor-resistive signal types on an individual basis for connecting any status or sensing device. Analog resolution shall be minimum 10-bit A to D.
2. Outputs. Controller input/output board shall support plug-and-play I/O modules or built-in HAO modules configured with manual-auto-off override switch, potentiometer and input channel for feedback status or an unrelated analog or digital input. Output supported shall be 0-10 VDC. All HAO's shall be supervised.
3. Diagnostics. Controller input board shall have variable intensity LEDs providing input status indication. Outputs shall have variable intensity LEDs indicating the output voltage with Color indication of HAO's status when present.

4. Bump-less Transfer. On analog outputs with override switches, provide a Hand-Auto-Off switch either built-in or external to the board that allows for manual positioning of the output, then transferring the output to automatic without any "bump" in the output voltage (don't go through off before transferring from manual to auto).

2.7 ADVANCED APPLICATION CONTROLLERS

- A. General. Provide an adequate number of BACnet® Advanced Application Controllers to achieve the performance specified in the Part 1 Article on "System Performance." Each of these panels shall meet the following requirements.

1. The Advanced Application Controller shall have sufficient memory to support its operating system, database, and programming requirements.
2. Advanced Application Controllers shall be fully peer to peer.
3. The operating system of the Controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information, and allow central monitoring and alarms.
4. All equipment that requires scheduling shall be scheduled in that equipment controller.
5. Both firmware and controller database shall be loadable over the network.
6. Advanced Application Controllers shall support the following BACnet Interoperability Building Blocks (BIBBs):

Data Sharing	Alarm & Event	Scheduling	Trending	Device & Network Mgmt.
DS-RP-A,B	AE-N-I-B	SCH-I-B	T-VM-I-B	DM-DDB-A,B
DS-RPM-B	AE-N-E-B	SCH-E-B	T-VM-E-B	DM-DOB-A,B
DS-WP-A,B	AE-ACK-B		T-ATR-B	DM-DCC-B
DS-WPM-B	AE-ASUM-B			DM-TS-B
DS-COV-A,B	AE-ESUM-B			DM-RD-B
	AE-INFO-B			DM-BR-B
				DM-R-B
				DM-OCD-B

- B. Communication.

1. Each Advanced Application Controller shall reside on a BACnet network using the MS/TP or Ethernet Data Link/ Physical layer protocol.
2. The controller shall provide a service communication port using BACnet Data Link/ Physical layer protocol for connection to portable operator's workstation and allow access to the entire network.

- C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at 0°C to 40°C [32°F to 100°F].
2. Controllers used in conditioned space shall be mounted in dust-proof enclosures, and shall be rated for operation at 0°C to 50°C [32°F to 120°F].

- D. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips — or to a termination card connected by a ribbon cable.

- E. Memory. The Advanced Application Controller shall be non-volatile FLASH memory.

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- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m [3 ft].

2.8 APPLICATION SPECIFIC CONTROLLERS

- A. General. Provide BACnet® Application Specific Controllers (ASCs) as required to execute the sequence of operations. ASC's are microprocessor-based DDC controllers which through hardware or firmware design are able to control a wide variety of equipment. They shall be fully user-configurable.
 - 1. Each ASC shall be capable of standalone operation and shall continue to provide control functions without being connected to the network.
 - 2. Each ASC will contain sufficient I/O capacity to control the target system.
 - 3. Both firmware and controller database shall be loadable over the network
 - 4. ASC's shall come with an integrated housing to allow for easy mounting and protection of the circuit board. Only wiring terminals shall be exposed.
 - 5. Application Specific Controllers shall support the following BACnet Interoperability Building Blocks (BIBBs):

Data Sharing	Alarm & Event	Scheduling	Trending	Device & Network Mgmt.
DS-RP-B				DM-DDB-B
DS-RPM-B				DM-DOB-B
DS-WP-B				DM-DCC-B
DS-COV-B				DM-TS-B
				DM-RD-B

- B. Communication
 - 1. The controller shall reside on a BACnet network using the MS/TP Data Link/ Physical layer protocol or BACnet® over ZigBee protocol.
 - 2. Each controller shall have a BACnet Data Link/ Physical layer compatible connection for a laptop computer or a portable operator's tool. This connection shall be extended to a space temperature sensor port where shown and allow access to the entire network.
- C. Environment. The hardware shall be suitable for the anticipated ambient conditions.
 - 1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°C to 65°C [-40°F to 150°F] and/or suitably installed in a heated or fan cooled enclosure
 - 2. Controllers used in conditioned space shall be mounted in dust-proof enclosures, and shall be rated for operation at 0°C to 50°C [32°F to 120°F].
- D. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips.
- E. Memory. The Application Specific Controller shall use non-volatile memory and maintain all BIOS and programming information in the event of a power loss.
- F. Immunity to power and noise. ASC shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m [3 ft].

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- G. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.
- H. Input/Output. ASC shall support as a minimum, directly connected, a combination of analog outputs and binary outputs and universal software selectable analog or digital inputs. ASC inputs shall support 0-5 VDC-voltage, 4-20mA-current, thermistor-resistance and dry contacts. ASC outputs shall support 0-10 VDC-voltage, digital triac rated at 0.5 amps at 24 VAC.

2.9 INPUT/OUTPUT INTERFACE

- A. Hardwired inputs and output points/objects may be wired into the system through Building, Advanced Application, or Application Specific Controllers.
- B. All input and output points shall be protected such that shorting of the point to itself, to another point, or to ground, will cause no damage to the controller. All input and output points shall be protected from voltage up to 24 volts of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Digital inputs shall allow the monitoring of ON/OFF signals from remote devices. The digital inputs shall provide a current of at least 12 mA to be compatible with commonly available control devices, and shall be protected against the effects of contact bounce and noise. Digital inputs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
- D. Analog inputs shall allow the monitoring of 0-5 VDC, 0-10 VDC-voltage, 4-20 mA-current, or thermistors. Analog inputs shall be compatible, and be field configurable to commonly available sensing devices.
- E. Digital outputs shall provide for ON/OFF operation. Digital outputs on Building and Advanced Application Controllers shall have three-position override switches, Hand-Off-Auto with status lights. Outputs shall be selectable for either normally open or normally closed operation.
- F. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide a 0 to 10 VDC signal as required to provide proper control of the output device. Analog outputs on Building or Advanced Application Controllers shall have status lights and a two-position (AUTO/MANUAL) switch and manually adjustable potentiometer for manual override. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.
- G. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct mounted heating coils, zone dampers, radiation, etc.)
- H. Input/Output points/objects shall be universal type, i.e., controller input or output may be designated (in software) as either a binary or analog type point/object with appropriate properties. Application Specific Controllers are exempted from this requirement.
- I. System Object Capacity. The system size shall be expandable to at least twice the number of input/output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement.

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2.10 AUXILIARY CONTROL DEVICES

A. Motorized control dampers, shall be provided by the mechanical contractor and are shown here for coordination purposes and shall be as follows:

1. Control dampers shall be parallel or opposed blade type as below or as scheduled on drawings.
 - a. Outdoor and/or return air mixing dampers and face and bypass (F&BP) dampers shall be parallel blade, arranged to direct air-streams toward each other. To provide proper flow control and minimize hunting all modulating dampers shall be sized to provide authority over airflow. Two position dampers shall be line size.
 - b. Other modulating dampers shall be opposed blade type.
 - c. Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.
2. Damper frames shall be 13 gauge galvanized steel channel or 1/8" extruded aluminum with reinforced corner bracing.
3. Damper blades shall not exceed 20 cm [8"] in width or 125 cm [48"] in length. Blades are to be suitable for medium velocity performance (10 m/s [2,000 fpm]). Blades shall be not less than 16 gauge.
4. Damper shaft bearings shall be as recommended by manufacturer for application, Oilite or better.
5. All blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 50 L/s·m² [10 cfm per sq. ft.] at 1000 Pa [4" w.c.] differential pressure. Provide air foil blades suitable for a wide-open face velocity of 7.5 m/s [1,500 fpm].
6. Individual damper sections shall not be larger than 125 cm x 150 cm [48" x 60"]. Provide a minimum of one damper actuator per section.
7. To provide proper flow control and minimize hunting all modulating dampers shall be sized to provide authority over airflow. Two position dampers shall be line size.
8. Dampers shall have exposed linkages.

B. Electric Damper/Valve Actuators

1. Actuators shall be manufactured by Belimo.
2. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
3. Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing.
4. All rotary spring-return actuators shall be capable of both clockwise and counter-clockwise spring-return operation. Linear actuators shall spring-return to the retracted position.
5. Proportional actuators shall accept a 0 to 10 VDC or 2 to 10vdc operating range.
6. All 24 VAC/VDC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not require more than 11 VA.
7. All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring-return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose.
8. Actuators shall be provided with a raceway fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

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9. Actuators shall be UL Standard 873 Listed and CSA Class 4813 02 Certified as meeting correct safety requirements and recognized industry standards.
10. Actuators shall be designed for a minimum of 60,000 full-stroke cycles at the actuator's rated torque.

C. Control Valves.

1. Control valves shall be two-way pressure independent ball valves for two-position or modulating service as shown as manufactured by Belimo.
2. All valves not on emergency power shall be normally closed for chilled water and normally open for hot water. Dual purpose valves shall fail closed on power failure.
3. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following 150% of total pump head pressure:
4. Body and trim style and materials shall be per Belimo's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
5. Sizing Criteria:
 - a. Two-position service: Line size
 - b. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35kPa [5 psi], whichever is greater.
 - c. Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa [5 psi] maximum.
 - d. Valves ½" through 2" shall be bronze body or cast brass ANSI Class 250, spring-loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
 - e. 2½" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing.
6. Water valves shall fail normally open or closed as indicated on plans which when indicated, supersede the following schedule:
 - a. Chilled beam zone valves - normally closed.
 - b. Heating coils in air handlers - normally open.
 - c. Chilled water control valves - normally closed.
 - d. Other applications - as scheduled or as required by sequences of operation. All modulating valves over 1" shall be energy valves with BACnet communications providing flow, temperature and BTU data to the BMS and shall contain logs for querying by the BMS input to maintain design differential temperature across the load.

D. Binary Temperature Devices

1. Low-voltage space thermostat shall be 24 V, bimetal-operated, with either adjustable or fixed anticipation heater, concealed set point adjustment, 13°C to 30°C [55°F to 85°F] set point range, 1°C [2°F] maximum differential, and vented ABS plastic cover.
2. Line-voltage space thermostat shall be bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed set point adjustment, 13°C to 30°C [55°F to 85°F] set point range, 1°C [2°F] maximum differential, and vented ABS plastic cover.
3. Low-limit thermostats. Low-limit thermostats shall be vapor pressure type with an element 6 m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any 30 cm [1 ft] section. The low-limit thermostat shall be manual reset only and be supplied as DPST.

E. Temperature Sensors

1. Temperature sensors shall be thermistors.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5 m [5 feet] in length.
3. Immersion sensors shall be provided with a separable brass well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Space sensors shall be equipped with the following:
 - a. Programmable buttons for set point adjustment and override.
 - b. 3-value, 96-segment LCD display.
 - c. Communication port connected to entire network.
5. Provide matched temperature sensors for differential temperature measurement.

F. Room Controllers

1. General

- a. Provide BACnet wall-mounted room controller (RC) as required to execute the sequence of operations.
- b. Each RC will contain sufficient I/O capacity to control the target system.
- c. Both firmware and controller database shall be loadable over the network.
- d. RC's shall come with an integrated housing to allow for easy mounting and protection of the circuit board and sensors. Only wiring terminals shall be exposed.
- e. Depending on the requirements found in the sequence of operations the RC shall house Temperature, relative humidity, CO₂ and motion sensors. The CO₂ and RH sensors shall be field replaceable components.
- f. The RC shall protrude no more than 1" from the wall. Multiple sensors (for humidity, CO₂ and temperature) are not allowed in order to meet this restriction.
- g. The RC shall be comprised of two parts allowing for a two phase installation. The first part shall be a back plate bearing minimal electronic components and shall be minimally visible upon final installation. The second component shall be the faceplate bearing the sensitive components that will be visible upon the completion of the installation allowing for final installation to be carried out when all surfaces have been painted and construction dust is minimal.
- h. The RC shall come with optional set screw allowing for the securing of the faceplate to the attached back plate of the RC. If undesired, the RC shall include an integral mean of securely fastening the faceplate to the base without the requirement of additional tools or materials to the device.
- i. The RC shall have a minimum of eight programmable zones for single touch user interaction. The provided RC shall also have a touch sensitive slider zone capable of providing visual feedback to the user. All zones must be programmable inputs to the system allowing for flexible sequence of operation. Individual zones must be able to be combined to create larger touch zones.
- j. RC backlight shall illuminate automatically based on user interaction. Where motion detection option is specified, backlight shall activate automatically based on user approach. In both cases, backlight shall dim based on programmable time out.
- k. RC shall have RIB backlight capable of displaying a range of colors. Backlight shall be (programmable/user adjustable/variable based on input). The RC backlight shall signify when the controlled equipment has been commanded into heating, cooling or economy mode with a red, blue and green light respectively.

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- i. The RC shall signal when an alarm has been sent from the third party notification system. The RC will display a flashing color as specified by the alarm code of the occupant.
- m. Local annunciation at or near the room sensor is required for the “natural ventilation” mode of operation. Provide LED annunciator, indicator light or other means of displaying the status of the system. LCD icons alone are not sufficient. Indicator must be clearly visible 50’ away from the room sensor. Overhead LED annunciator is acceptable.
- n. The provided RC shall have backlit buttons or a backlit button interface allowing full use of all features and functions of the device in a dark environment.

2. Communications

- a. The controller shall reside on a BACnet network using the MS/TOP Data Link/Physical layer protocol or BACnet[®] over ZigBee protocol.
- b. Each controller shall have a BACnet Data Link/Physical layer compatible micro USB connection for a laptop computer or a portable operator's tool. This connection shall be extended to a space temperature sensor port where shown and allow access to the entire network. The provided RC shall come with a micro USB service portable operator's tool. This connection shall be extended to a space temperature sensor port where shown and allow access to the entire network. The provided RC shall come with a micro USB service port allowing for limited access to the network. This service port shall also have the capability to be disabled via software preventing any and all access to the network via that port if so desired.
- c. RC must have NFC communication chip onboard allowing for wireless configuration and addressing of the device via smartphone, tablet or other like device.

- 3. The Room Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120Hz and from keyed radios up to 5W at 1m [3 ft.].

G. Humidity Sensors

- 1. Sensors shall have a sensing range of 20% to 80%.
- 2. Duct sensors shall be provided with a sampling chamber.
- 3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH. They shall be suitable for ambient conditions of -40°C to 75°C [-40°F to 170°F].
- 4. Humidity sensor's drift shall not exceed 3% of full scale per year.

H. Relays

- 1. Control relays shall be UL Listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application
- 2. Time delay relays shall be UL Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable $\pm 200\%$ (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

I. Fume Hood Override Timers

1. Override timers shall be spring-wound line voltage UL Listed, contact rating and configuration as required by application. Provide 0-to-2-hour calibrated dial unless otherwise specified; suitable for flush mounting on control panel face, located on local control panels or where shown. Mounted on each hood, the BMS shall monitor the timer directly to facilitate the sequence of operations found in section 230993. The prep hood shall not incorporate a manual switch as it is designated for 24/7 operation. An LED indicator shall indicate if the hood is in operation. Green illuminated for airflow on ON and green extinguished for no air flow or OFF.

J. Current Transmitters

1. AC current transmitters shall be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 0 – 5vdc two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, internal zero and span adjustment, and $\pm 1\%$ full scale accuracy at 500 ohm maximum burden
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation.

K. Power Monitors

1. Carry an allowance for the upgrade of the Con Ed meter to an interval meter with pulse output for integration to the BMS.

L. Current Switches

1. Current operated switches shall be self-powered, solid-state with adjustable range for the monitored.

M. Pressure Transducers

1. Transducer shall have linear output signal. Zero and span shall be field-adjustable.
2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage
3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 1 - 5vdc or 4 to 20 mA output, required mounting brackets, and block and bleed valves.
4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 1 – 5vdc or 4 to 20 mA output, required mounting brackets, and five-valve manifold.

- N. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application, or as shown.

M. Ultrasonic Chilled and Hot Water BTU Monitoring Devices

1. Flow Meter/Transmitter
 - a. Liquid Flow Meter System Requirements

Intrinsic Accuracy: Within 1 percent of actual flow above 1 fps.

Calibrated Accuracy; 0.5 percent of actual flow above 1 fps.
Sensitivity: 0.001 ft/sec.

2. Energy Metering System

- a. The metering system shall consist of an Onicon System F-4000 flow meter, temperature sensors for supply and return and a computer with, individual flow data display complete metallic mounting hardware.
- b. Where more than one meter is installed in a room a multi-channel meter is desirable.
- c. The system shall be field-programmable with all site criteria being capable of input or change on-site by the use of plug-in hand-held terminal. All programming will be menu driven and input in plain English.
- d. Computer shall maintain a BTU totalizer so that if communication is interrupted to the BMS it shall pick up the total upon restoration of communications.
- e. System Requirements

- 1). Onicon System 10 BTU computer.

3. Flow Meter Installation, Programming and Start-Up

- a. The manufacturer and/or factory representative of the flow meter shall provide field supervision at the project site for the installation of the flow metering equipment. The manufacturer and/or factory representative of the flow meter shall provide on-site programming and the flow-meter, installation check and commissioning of the flow-meter.

O. Local Control Panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with hinged door, key-lock latch, and removable sub-panels. A single key shall be common to all field panels and sub-panels
2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings
3. Provide 120v receptacle at each local panel location.

2.11 WIRING AND RACEWAYS

- A. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 260000.
- B. All control and interlock wiring required to perform work under this section shall be provided under this scope of work.
- C. The following power wiring will be provided under Division 260000, all other wiring will be provided under this scope of work:

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1. Standby Power on Emergency Generator (90 second or more delay) for the server in cellar facilities office; 1 pole 20 amp circuit terminating in junction box at each fan room (cellar, 10th floor, 11th floor); in boiler room on 11th floor; and two 1 pole 20 amp on alternating circuits terminating in junction box at each electric closet and IDF closet floors C-11 (12).
 2. Normal 120 volt power to each VAV box, Air Valve Power.
- D. All insulated wire to be copper conductors, UL labeled for 90C minimum service.
- E. Provide stubups for each wall mounted device required to meet the specification. Coordinate all locations with the owner and owner's representative before installing wall mounted devices or supporting conduit.

PART 3 - EXECUTION

3.1 SECTION INCLUDES

- A. Examination
- B. Protection
- C. Coordination
- D. General Workmanship
- E. Field Quality Control
- F. Existing Equipment
- G. Wiring
- H. Communication Wiring
- I. Installation of Sensors
- J. Flow Switch Installation
- K. Actuators
- L. Identification of Hardware and Wiring
- M. Controllers
- N. Programming
- O. Control System Checkout and Testing
- P. Control System Demonstration and Acceptance
- Q. Cleaning
- R. Training

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3.2 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started
- B. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started
- C. The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate — or if any discrepancies occur between the plans and the Contractor's work, and the plans and the work of others — the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by — and at the expense of — this Contractor.

3.3 PROTECTION

- A. The Contractor shall protect all work and material from damage by its work or employees, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.4 COORDINATION

- A. Site
 - 1. Where the mechanical work will be installed in close proximity to, or will interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs its work before coordinating with other trades, so as to cause any interference with work of other trades, the Contractor shall make the necessary changes in its work to correct the condition without extra charge.
 - 2. Coordinate and schedule work with all other work in the same area, or with work which is dependent upon other work, to facilitate mutual progress.
- B. Submittals. Refer to the "Submittals" Article in Part 1 of this specification for requirements.
- C. Test and Balance
 - 1. The Contractor shall furnish all tools necessary to interface to the control system for test and balance purposes.
 - 2. The Contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
 - 3. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.

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4. The tools used during the test and balance process will be returned at the completion of the testing and balancing.

D. Life Safety

1. Duct smoke detectors required for air handler shutdown are supplied and installed under Division 260000. The Division 260000 Contractor shall interlock smoke detectors to air handlers for shutdown as described in "Sequences of Operation".
2. Smoke dampers and actuators required for duct smoke isolation are provided under another Division 230000 Section.
3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Division 230000 Section. Control of these dampers shall be by Division 260000.
4. Provide UL864 equipment and communications for all smoke control systems. Coordinate design, installation and testing with the FAS installer.

- E. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the Contractor as follows:

1. All communication media and equipment shall be provided as specified in Part 2: "Communication" of this specification.
2. Each supplier of controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.
3. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this Section and those provided under other sections or divisions of this specification.

3.5 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment
- C. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).
- D. All wiring shall be verified for its integrity to ensure continuity and freedom from shorts and grounds
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.6 FIELD QUALITY CONTROL

- A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

- C. Contractor shall have work inspected by local and/or state/provincial authorities having jurisdiction over the work.

3.7 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes and Division 260000 of this specification. Where the requirements of this section differ with those in Division 260000, the requirements of this section shall take precedence.
- B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC
- C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
- D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations including ceiling return air plenum, approved cables not in EMT may be used, provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenum shall be UL Listed specifically for that purpose.
- E. All wiring in mechanical, electrical, or service rooms — or where subject to mechanical damage — shall be installed in EMT at levels below 10ft. All wiring in the loading dock shall be installed in rigid conduit.
- F. Do not install Class 2 wiring in EMT containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- G. Do not install wiring in raceway containing tubing.
- H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it, and *neatly* tied at 6ft intervals.
- I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.
- J. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.
- K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the Contractor shall provide step-down transformers.
- M. All wiring shall be installed as continuous lengths, with no splices permitted between termination points/objects.
- N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

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- O. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements, except as noted elsewhere.
- P. Include one pull string in each raceway 1" or larger.
- Q. Use coded conductors throughout with different colored conductors.
- R. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- S. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6" from high-temperature equipment (e.g., steam pipes or flues).
- T. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- U. Adhere to Division 260000 requirements where raceway crosses building expansion joints.
- V. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.
- W. The Contractor shall terminate all control and/or interlock wiring, and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- X. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 ft in length and shall be supported at each end. Flexible metal raceway less than ½ "electrical trade size shall not be used. In areas exposed to moisture — including chiller and boiler rooms — Emt with compression fittings to liquid tight boxes to within 3 ft of all devices or panels for transition to liquid-tight flexible metal raceways.
- Y. Raceway must be securely installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.8 COMMUNICATION WIRING

- A. The Contractor shall adhere to the items listed in the "Wiring" Article in Part 3 of the specification.
- B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- C. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
- D. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.
- E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

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- F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.
- G. All runs of communication wiring shall be un-spliced when that length is commercially available.
- H. All communication wiring shall be labeled to indicate origination and destination data.
- I. Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding.

3.9 INSTALLATION OF SENSORS

- A. Install all sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for the environment within which the sensor operates
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Should wall mounting be unavailable, the proper sensor should be furnished to accommodate the situation.
- D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip.
- F. Low limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1ft of capillary for every 1 ft² of coil area. All capillary shall be mounted in the air stream.
- G. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.
- I. Differential Air Static Pressure
 - 1. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable), or to the location of the duct high-pressure tap and leave open to the plenum.
 - 2. Return Duct Static Pressure: Pipe the low-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor
 - 3. Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover at the specified location
 - 4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer

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5. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment
6. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee

3.10 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
 1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage
 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 3. Provide all mounting hardware and linkages for actuator installation.
- B. Electric/Electronic
 1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
 2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.11 IDENTIFICATION OF HARDWARE AND WIRING

- A. All work shall be labeled in accordance with section 230553 "Identification for HVAC Piping and Equipment."
- B. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 5 cm [2"] of termination with the DDC address or termination number.
- C. All pneumatic tubing shall be labeled at each end within 5 cm [2"] of termination with a descriptive identifier.
- D. Permanently label or code each point/object of field terminal strips to show the instrument or item served.
- E. Identify control panels with minimum 1 cm [½"] letters on laminated plastic nameplates.
- F. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
- G. Identify room sensors relating to terminal box or valves with nameplates.
- H. Manufacturers' nameplates.
- I. Identifiers shall match record documents.

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3.12 PROGRAMMING

- A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.
- B. Point/object Naming: System point/object names shall be modular in design, allowing easy operator interface without the use of a written point/object index. Object names shall be case-sensitive and clearly spell out the function of each object. Submit naming scheme to owner for prior approval. Do not use cryptic abbreviations. Valid examples are:
 - 1. AHU-1 Supply Air Temperature
 - 2. CH-1 Chilled Water Supply Temperature
 - 3. FC-1 Room Temperature
 - 4. VAV-103 Room Temperature Trend
- C. Software Programming
 - 1. Provide programming for the system and adhere to the sequences of operation provided. The Contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:
 - a. Text-based
 - 1) Must provide actions for all possible situations.
 - 2) Must be modular and structured.
 - 3) Each line must be commentable.
 - b. Graphic-based
 - 1) Must provide actions for all possible situations.
 - 2) Must be documented with pdf versions of all programs. All programs for a single system must be printed on one piece of paper. Paper size must allow for adequate font size. Programs written across pages with match lines are not acceptable.
 - 3) Provide full size examples prior as part of the preapproval process.
 - c. Parameter-based
 - 1) Unacceptable
- D. Operator Interface
 - 1. Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point/object information on the graphic displays shall dynamically update. Show on each graphic all input and output points/objects for the system. Also show relevant calculated points/objects such as set points.
 - 2. Show terminal equipment information on a "graphic" summary table. Provide dynamic information for each point/object. All floor plans shall have a layer that can be turned on and off showing all equipment ductwork, ductwork, diffusers, piping and wall sensor locations.

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3. The Contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all server software and their functions as described in this section. This includes any operating system software, the Operator Workstation database, and any third-party software installation and integration required for successful operation of the operator interface.

3.13 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Start-up Testing: All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner witnessed calibration and commissioning process.

1. The Contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
2. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.
4. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
5. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel
6. Verify that the system operation adheres to the Sequences of Operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimum Start/Stop routines.
7. Alarms and Interlocks
 - a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
 - b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.14 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration

1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests.
2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, startup, and debugging process and as specified in the "Control System Checkout and Testing" Article in Part 3 of this specification. The Commissioning Agent will be present to observe and review these tests. The Commissioning Agent shall be notified at least 10 days in advance of the start of the testing procedures.

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3. The demonstration process shall follow that approved in Part 1: "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. The Contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor.
5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed. Demonstrate calibration and response of any input and output points requested by Commissioning Agent. Provide and operate test equipment required to prove proper system operation.
6. Demonstrate compliance with Part 1: "System Performance.
7. Demonstrate compliance with Sequences of Operation through all modes of operation
8. Demonstrate complete operation of the server.
9. Additionally, the following items shall be demonstrated:
 - a. DDC Loop Response. The Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
 - b. Demand limiting. The Contractor shall supply a trend data output showing the action of the demand-limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of shed-able equipment outputs.
 - c. Optimum Start. The Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
 - d. Interface to the building fire alarm system.
 - e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the Architect/Engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
 - f. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance

1. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: "Submittals."

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3.15 CLEANING

- A. The Contractor shall clean up all debris resulting from its activities daily. The Contractor shall remove all cartons, containers, crates, etc., under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- B. At the completion of work in any area, the Contractor shall clean all of its work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.17 TRAINING

A. General

- 1. Provide a minimum of three onsite training classes 8 hours in length each during the construction period for personnel designated by the owner.

B. Train the designated staff of Owner's Representative and Owner to enable Day-to-day Operators to:

- 1. Proficiently operate the system.
- 2. Understand the HVAC and Lighting Systems.
- 3. Understand control system architecture and configuration.
- 4. Understand DDC system components.
- 5. Understand system operation, including DDC system control and optimizing routines (algorithms).
- 6. Operate the peripherals.
- 7. Log on and off the system.
- 8. Access graphics, point/object reports, and logs.
- 9. Adjust and change system set points, time schedules, and holiday schedules.
- 10. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
- 11. Understand system drawings, and Operation and Maintenance manual.
- 12. Understand the job layout and location of control components.
- 13. Access data from DDC controllers and Application Specific Controllers (ASC's).
- 14. Operate portable operator's terminals.

C. Train the designated staff of Owner's Representative and Owner to enable Advanced Operators to:

- 1. Make and change graphics on the server.
- 2. Create, delete, and modify alarms, including annunciation and routing of these.
- 3. Create, delete, and modify point/object trend logs, and graph or print these.
- 4. Create, delete, and modify reports.
- 5. Add, remove, and modify system's physical points/objects.
- 6. Create, modify, and delete programming.
- 7. Add panels when required.
- 8. Create, delete, and modify system displays — both graphical and otherwise.

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9. Perform DDC system field checkout procedures.
 10. Perform DDC controller unit operation and maintenance procedures.
 11. Perform server and peripheral operation and maintenance procedures.
 12. Perform DDC system diagnostic procedures.
 13. Configure hardware including PC boards, switches, communication, and I/O points/objects.
 14. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
 15. Adjust, calibrate, and replace system components.
- D. Train the designated staff of Owner's Representative and Owner to enable System Managers/Administrators to:
1. Maintain software and prepare backups.
 2. Interface with job-specific, third-party operator software.
 3. Add new users and understand password security procedures.
- E. Provide course outline and materials as per "Submittals" Article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.
- F. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- G. Classroom training shall be done using a network of working controller's representative of the installed hardware.
- H. Classroom training shall be videotaped and delivered to owner.

END OF SECTION

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SECTION 230993

SEQUENCE OF OPERATIONS

PART 1 - GENERAL

1.1 GENERAL

- A. Control of each air conditioning system, fan coil unit, VAV terminal unit, exhaust fan, water system, etc. shall be accomplished by a DDC system.
- B. All control algorithms, computation functions and energy management functions shall be software based and reside in the DDC system. The operator shall have the capability through the operator workstation to access all programs, display all data resident in the system memory, and perform analog and digital functions at each DDC Controller.
- C. All motors shall be provided with Hand-Off-Auto switches located at the starter or Hand-Off-Inverter-Bypass switch located at the VFD. Motors can be started locally by placing these switches in the Hand or bypass position. These switches should be placed into the Auto or Inverter position for operation by the BMS.
- D. All hardwired interlocks shall operate regardless if a fan or motor is started locally in Hand or through the BMS in Auto.
- E. A failure alarm, as included in the point list, shall indicate the type of equipment that has failed (pump, fan, valve, etc.) including the specific designation of the piece of equipment (e.g., supply fan SF-1). It is not acceptable to generate a general failure alarm.
- F. All software setpoint shall be adjustable by the operator via the operator workstation.
- G. Analog inputs such as temperature, pressure, humidity, and flow transmitters shall be wired directly to the controller serving the mechanical equipment where the transmitter is install, with exception to Outdoor Air Temperatures, Humidity, and CO2 levels which can be used globally by the BMS.
- H. This contractor shall coordinate with the air and water system balancer to establish all required setpoints for fan static pressures and water system differential pressures.
- I. All points required by the sequence of operation including, but not limited to, the points listed in the sequences of operation below, as well as all pf the points' associated values, shall be connected to the BMS and available to the BMS operators on all operator workstations and all operator interface devices as part of a graphical display that depicts the mechanical system controlled.
- J. The point lists are provided for convenience and are not intended to be all-inclusive. All points required to provide the Sequence of Operation shall be included as if listed.

- K. Coordinate mounting locations of all control panels with the General Contractor, Owner, Engineer, and Architect. All control panels shall be located such that there is sufficient access required to properly service the panel.
- L. For all fans above 2000 CFM a smoke detector provided and installed by the HVAC contractor will shut down the fan upon detection of smoke.
- M. The following sections shall also be referenced:
 - 1. VOC limits for Adhesives, Sealants, Paints and Coatings.
 - 2. Construction and Demolition Waste Management.
 - 3. Construction Indoor Air Quality (IAQ) Management Section 018103
 - 4. Commissioning Section 230800

PART 2 – VAV WITH REHEAT

2.1 GENERAL

- A. Provide Terminal Equipment control as indicated on plans. Where multiple sensors are indicated for a single VAV, the BMS shall control to one sensor and not allow any other sensor to be more than 3 degrees from zone setpoint.
- B. Controllers shall be factory mounted, coordinate mounting and wiring of all terminal unit controls with the box manufacturer.
- C. The VAV boxes are to be powered via 24 VAC low voltage circuit. The BMS vendor shall furnish all necessary transformer(s) and panels to provide sufficient power for each VAV. 120VAC circuits will be provided under this scope of work in accordance with the requirements of the Electrical Section of the Specifications, Division 260000.
- D. The BMS vender shall furnish, install, and wire all controls not furnished, installed or wired by others in order to achieve required sequences.
- E. VAV Damper, enclosure, and flow cross shall be provided by the Terminal Unit Manufacturer.
- F. Minimum and maximum airflow setting shall be those scheduled on the plans.
- G. Provide Space CO2 Sensors where indicated on plans. For Terminal Units with space CO2 sensors implement the Zone Demand ventilation sequence.

2.2 RUN CONDITIONS

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- A. The unit will run according to a user definable schedule in the occupied and unoccupied modes. Setpoints for each mode of operation will be adjustable.

- B. The BMS vendor will provide occupant override pushbuttons on all wall sensors for areas served by AHU for after-hours occupancy override. The button will provide 1 additional hour (sdj) of operation.

- C. Occupants will be able to adjust a zone temperature setpoint range at the zone sensor with a slider.
- D. Alarms will be provided for the following
 - High Zone Temp – If the zone temperature is great than the Setpoint by a user defined amount.
 - Low Zone Temp – If the zone temperature is less than the Setpoint by a user defined amount.

2.3 OCCUPIED

- A. When the zone temperature is greater than the Setpoint the zone damper will modulate between the minimum occupied airflow Setpoint and the maximum occupied airflow Setpoint until the zone is satisfied.
- B. When the zone temperature is less than the Setpoint the zone damper will modulate between the minimum occupied airflow Setpoint and the maximum occupied airflow Setpoint until the zone is satisfied.
- C. If the VAV is controlling at the minimum occupied airflow setpoint and the temperature remains less than the setpoint or continues to decrease below the setpoint the controller will modulate the reheat coil control valve to maintain zone temperature at setpoint.
- D. (Zones With Hot Water Radiation) Radiation will be enabled when the outside air temperature is less than 55 degrees (Adj.). The radiation will be the 1st stage of heat. VAV-re-heat 2nd Stage.

2.4 UN-OCCUPIED

- A. When the Air Handling unit serving the VAV is not running the damper will modulate to full closed. The perimeter radiation zone valve shall modulate to maintain zone un-occupied set point.
- B. When the zone is in the unoccupied mode and the Air Handling unit serving the VAV is running, the zone damper and the reheat coil control valve will control to maintain the Unoccupied Setpoint. The damper will go to full closed position when setpoint is reached.
- C. If the local override button is depressed the VAV will enter the Occupied mode for a defined adjustable duration.

PART 2 - VAV (W/ PERIMETER HEATING) TERMINAL UNITS

2.1 GENERAL

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- A. Provide Terminal Equipment control as indicated on plans. In general provide one controller and one zone temperature per VAV Terminal Unit. When more than one zone temperature is shown per VAV Terminal Unit the space average temperature shall be used for control. Where more than one VAV Terminal Unit is controlled by one space temperature when all VAV's shall control in unison.
- B. Controllers shall be factory mounted, coordinate mounting and wiring of all terminal unit controls with the box manufacturer.
- C. The VAV boxes are to be powered via 24VAC Low voltage circuit. The BMS vendor shall furnish all necessary transformer(s) and panels to provide sufficient power for each VAV. 120VAC Circuits will be provided under this scope of work in accordance with the requirements of the electrical Section of the Specifications, Division 260000.
- D. The BMS vendor shall furnish, install, and wire all controls not furnished, installed, or wired by others in order to achieve required sequences.
- E. VAV Damper, enclosure, and flow cross shall be provided by the Terminal Unit Manufacturer.
- F. Minimum and maximum airflow setting shall be those scheduled on the plans.
- G. Provide Space sensors without adjustments or displays.
- H. Provide ceiling mounted occupancy sensor.
- I. Occupied/unoccupied/warm-up schedules shall coordinate with the AHU serving those boxes

2.2 OCCUPIED MODE

- A. The box shall be indexed to occupied mode when the AHU serving these boxes is running and the ceiling mounted occupancy sensor has sensed movement within the past 2 hours.
- B. Upon a fall in space temperature below setpoint, the VAV box shall modulate the damper to the minimum CFM setting. Upon a rise in space temperature the VAV box damper shall modulate between the minimum and maximum CFM setting to maintain the space temperature setpoint. The minimum and maximum CFM settings shall be those scheduled on the mechanical drawings.
- C. Upon entering the heating season, the HW perimeter heating shall cycle to maintain the space temperature setpoint.

2.3 UNOCCUPIED MODE

- A. When the primary fan system serving the VAV box is not running or when the ceiling mounted occupancy sensor has not sensed movement in the past 2 hours, the VAV box damper shall close.

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- B. If the space temperature falls below the unoccupied setback temperature setpoint of 60°F or rises above the unoccupied setup temperature setpoint of 80°F, the fan system serving the VAV box shall be energized and the VAV box shall open 100%. If the box is calling for heat and there is hot water as sensed by the new strap-on hot water sensor, open the HW perimeter heating valve. The box damper shall go to minimum and the HW valve shall close when space reaches 64F or 76F.
- C. If 20% of the VAV box occupancy sensors sense movement when the AHU is not running, then the AHU shall be indexed to start.

2.4 SYSTEM POINTS

- A. Provide the following DDC points:
 1. Schedule occupied/unoccupied/override
 2. Space temperature
 3. Occupancy
 4. Space temperature setpoints, occupied
 5. Space temperature setpoints, unoccupied
 6. Current CFM
 7. CFM setpoint
 8. Perimeter heat command

PART 3 - HYDRONIC UNIT & CABINET HEATERS

4.1 GENERAL

- A. Provide Cabinet heater control as indicated on plans. Provide strap-on aqua-stat, control valve, and thermostat for standalone operation.
- B. Upon the aqua-stat sensing hot water in the pipe and the remote mounted thermostat sensing a drop in space temperature the control valve shall open and the unit shall run.
- C. The unit shall shutdown if any of the above conditions are not met.

PART 4 - TOILET EXHAUST FANS – EF-1

4.1 GENERAL

- A. BMS contractor shall provide any interlock wiring to the fans associated damper.
- B. As indicated on electrical drawing, TEF-1 is tied to an intelligent centralized lighting control system with timeclock functionality for on/off control through a time of day schedule.

PART 5 - VARIABLE AIR VOLUME AIR HANDLING UNITS (AHU-6/RF-6, AHU-7/RF-7)

5.1 GENERAL

- A. Provide Air Handling Unit Control for system shown on drawing.
- B. The BMS vendor shall furnish, install, and wire all controls and devices in the field to accomplish the desired sequence of operations.
- C. The unit is a variable air volume Air Handling Unit with a Heating Coil and Cooling Coil. Downstream Variable Air Volume Terminal units shall control individual zone temperatures.
- D. The outside air intake shall be comprised of a damper. The damper is to be provided with an IAQ airflow station to measure the airflow.

5.2 SAFETIES

- A. The Return Air Smoke detector shall stop the supply fans upon the presence of smoke through the FAS. Smoke detector provided and wired by the Fire Alarm Vendor to the FAS. The Fire Alarm Vendor shall provide a fan shutdown relay adjacent to the unit VFD.
- B. A freezestat shall be installed downstream of the heating coil and upstream of the cooling coil and shall de-energize the supply fan upon sensing a temperature below 40^oF. Upon detection of a freeze condition the heating coil control valve shall modulate to maintain a coil discharge air temperature of 90^oF.
- C. Low suction and high static air pressure switches located upstream and downstream of the supply fan and downstream of the closest damper shall stop the fan upon a low suction or high static condition. An alarm shall be annunciated at the BMS.
- D. The static pressure shall be measured across the filter bank and shall indicate a dirty filter condition. A magnehelic differential pressure gage provided by the unit manufacturer shall be installed across the filter bank to provide local ideation of the differential pressure across the filter. An alarm shall be annunciated at the BMS.
- E. Leak Detection. Upon activation of the leak detection all fans shall be shut down, dampers closed, and control valves closed.
- F. Alarm shall be provided as follows:
 - 1. Fan Failure: Fan is commanded on and no airflow indication.
 - 2. Fan in Hand: Fan is commanded off and there is indication of airflow.
 - 3. Fan High Static or Low Suction.
 - 4. High/Low Temperature Alarms. (Mixed Air, Supply Air, Etc.).
 - 5. Freeze Condition. (via Freeze Stat).
 - 6. Leak Detection

7. Dirty Filter Alarm. (via Filter Differential Pressure Switch).

5.3 RUN CONDITIONS

- A. The Air Handling Unit shall be started and stopped through the BMS based upon a user defined schedule, or on a manual call for override through the BMS.
- B. Supply Fan Control:
 1. The Supply Fans shall be run anytime the unit is commanded to be on, unless shutdown on safeties.
 2. The DDC Controller shall measure supply duct static pressure and shall modulate the speed of the Supply Fans VFD to maintain duct Static Pressure at setpoint. Duct static pressure shall be measured 2/3 downstream from the supply fan. The fan VFD shall not drop below 30% of full speed.
- C. Heating Coil Control
 1. The DDC Controller shall measure the heating coil discharge air temperature and modulate the heating coil control valve to maintain the supply air discharge setpoint of 55°F (adj.).
 2. Heating shall be enabled when the outside air temperature is less than 50°F (adjustable), the economizer is disabled, and the supply fan is running.
 3. The heating coil control valve shall open for freeze protection when the coil discharge air temperature drops below 35°F or the Freeze-Stat.
- D. Supply Air Setpoint Control
 1. The Supply air setpoint shall be reset based on the cumulative demand of the of the VAV box controllers. As the cooling demand from the VAV controllers decreases the supply air temperature setpoint shall decrease.
 2. The DDC Controller shall maintain the supply air temperature at setpoint by modulating the Economizer Dampers and Cooling Coil Control Valve.
 3. When the supply fan is off the Cooling Coil Valve shall modulate to full close and the Economizer dampers shall modulate to 100% return air.
 4. Upon detection of a freeze condition by the Freeze-Stat the Cooling Coil Valve shall modulate to full open.
- E. Economizer Control
 1. The economizer shall be enabled whenever all the flowing conditions are met:
 - a. Outside Air Temperatures is less than 65°F (adjustable).
 - b. Outside Air Temperature is less than the return air temperature.
 - c. Supply Fan is on.

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2. The DDC controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a mixed air setpoint 2°F (adjustable) less than the supply air temperature setpoint. The minimum Outside air damper shall begin to modulate until it reaches 100% open. Upon the minimum outside air damper reaching 100% open and a call for more outside air is made the maximum outside air damper shall modulate to the fully closed position.
3. When Economizer mode is disabled the minimum outside air damper shall modulate to maintain a minimum airflow (adjustable) as measured by the Outside Airflow Station, and the maximum outside air damper shall modulate to the fully closed position.
4. The economizer shall be disabled whenever any of the following are true:
 - a. Mixed Air Temperature drops below 35°F (adjustable).
 - b. Freeze Condition is met as indicated by Freeze Stat.
 - c. Supply fan is off.
5. The outside air and exhaust air dampers shall modulate to full closed.
6. During morning warm-up or cool-down the outside air damper shall be held at full closed.

5.4 SYSTEMS POINTS

A. Provide the following points hardwired to the BMS:

1. Outside Air Airflow (AI)
2. Spill Airflow (AI)
3. Supply Airflow (AI)
4. Mixed Air Temperature (AI)
5. Cooling coil leaving air temp (AI)
6. Heating coil leaving air temp (AI)
7. Supply Air Temperature (AI)
8. Supply Air Static Pressure (AI)
9. Return Air Temperature (AI)
10. Return Air Humidity (AI)
11. Supply Stats via Current Sensor (BI)
12. Supply Fan VFD Fault (BI)
13. Filter Differential Pressure (BI)
14. SF High Static (BI)
15. SF Low Suction (BI)
16. Freezestat (BI)
17. Supply Fan Start/Stop (BO)
18. Supply Fan VFD Speed Signal (AO)
19. Cooling Coil Control Valve (AO)
20. Heating Coil Control Valve (AO)
21. Outside Air Dampers (AO)
22. Return Air Damper (AO)
23. Chilled Water Supply Temperature (AI)
24. Steam Supply Temperature (AI)

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PART 6 - EXISTING VARIABLE SPEED PUMPS

6.1 GENERAL

- A. Reconnect existing hot and chilled water pumps to BMS and maintain existing sequence of operation.

PART 7 - NEW CHILLED WATER PUMPS

7.1 GENERAL

- A. DDC controls for the Hot Water Pumps as indicated on the plans. (P-1,P-2)
- B. Pump configuration is Lead, Lag, Lag.
- C. The BMS Vendor shall furnish, install, and wire all controls not furnished, installed, or wired by others in order to achieve required sequences.

7.2 SAFETIES

- A. The BMS shall monitor status.
- B. Alarms shall be provided as follows:
 - 1. Pump Failure: Pump is commanded on and status is off.
 - 2. Pump in Hand: Pump is commanded off and status is on.
 - 3. Pump maintenance alarm: Pump requires maintenance based on runtime hours.
- C. The BMS shall command the Lag pump to run upon a failure of the Lead Pump. An alarm shall be sent to the BMS workstation.

7.3 RUN CONDITIONS

- A. The BMS shall start and stop the pumps manually or upon a call for chilled water. There shall be one pump designated as lead and the remaining pump shall be lag. The lead and lag pumps shall be alternated based on runtime or in the event of a pump failure.
- B. Pump shall operate in a Lead/Lag configuration and the BMS shall rotate the Lead pump based on runtime.
- C. The lead pump shall start whenever there is a call for chilled water. The lag Pump VFD control shall be enabled whenever the pump is called to run.

7.4 DIFFERENTIAL PRESSURE CONTROL

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- A. There shall be a differential pressure transmitter located in the end of the chilled water piping serving the FCUs. The differential pressure transmitter shall measure the differential pressure between chilled water water supply and return lines. This differential pressure transmitter shall control the chilled water by-pass valve installed across the chilled water supply and return piping. On increasing pressure the valve shall open to allow increase flow across the by-pass. On decreasing pressure, the valve shall close to allow for decrease flow across the by-pass. This differential pressure transmitter shall control the chilled water pump speed. The signals shall run through a controller to select the lower differential pressure reading. The lower reading shall be used to modulate the VFD's of the chilled water pumps. On a decrease in the differential pressure sensor below set point, the pump speed shall be increased. On an increase in the differential pressure sensor above set point, the pump speed shall be decreased.

7.5 SYSTEM POINTS

- A. Provide the following points hardwired to the BMS:
1. Pump VFD Fault (BI)
 2. Pump VFD Start/Stop (BO)
 3. Pump VFD Feedback (AO)
 4. Pump VFD Command (AO)

END OF SECTION 230993

SECTION 232113

HYDRONIC PIPING

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.
- B. Vibration Isolation, Seismic, Wind and Flood Load Restraints for HVAC, Plumbing, Electrical and Fire Protection Components for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Condenser-water piping.
 - 3. Makeup-water piping.
 - 4. Condensate-drain piping.
 - 5. Air-vent piping.
- B. Related Sections include the following:
 - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.
- B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
1. Hot-Water Heating Piping: 150 psig at 200 deg F.
 2. Condenser-Water Piping: 150 psig at 200 deg F.
 3. Makeup-Water Piping: 80 psig at 150 deg F.
 4. Condenser-Drain Piping: 150 deg F.
 5. Blowdown-Drain Piping: 200 deg F.
 6. Air-Vent Piping: 200 deg F.
 7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 SUBMITTALS

- A. Product Data: For each type of the following:
1. Piping and fittings.
 2. Pressure-seal fittings.
 3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 4. Air control devices.
 5. Chemical treatment.
 6. Hydronic specialties.
- B. Shop Drawings: Detail, at 3/8"=1'-0" scale, the piping layout (including plans, selections, and elevations), valving and instrumentation, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure with hanger point loads. Detail location of anchors, alignment guides, and expansion joints and loops. Indicate top and bottom elevations of all piping above finished floor. Indicate all equipment with coil clearances and coil pull spaces.
- C. Welding certificates.
- D. Qualification Data: For Installer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

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- G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.7 EXTRA MATERIALS

- A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.
- B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

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PART 2 - PRODUCTS

2.1 GENERAL

- A. All copper, steel, and plastic piping materials and fittings shall be manufactured in the United States. Submit mill certificates from the respective manufacturer.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L or ASTM B 88, Type M.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K hard drawn.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22, ASTM B-32.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - 2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
 - 3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
- E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. T-DRILL Industries Inc.
- F. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 to match system pressure.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 to match system pressures.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250: raised ground face, and bolt holes spot faced to match system pressures.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Weld end fittings: ANSI B16-9, ASTM A-234.
- I. Socket weld fittings: ANSI B16.11.
- J. Weldolets and Thredolets: ANSI B31.1.0.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

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- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

- A. Provide Dielectric fittings at all locations between disassembled metals. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Zum Plumbing Products Group; AquaSpec Commercial Products Division.
 - 2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

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2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Victaulic Company of America.
2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.6 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

2.7 AIR CONTROL DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amtrol, Inc.
 - 2. Armstrong Pumps, Inc.
 - 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
- B. Manual Air Vents:
 - 1. Body: Bronze.
 - 2. Internal Parts: Nonferrous.
 - 3. Operator: Screwdriver or thumbscrew.
 - 4. Inlet Connection: NPS 1/2.
 - 5. Discharge Connection: NPS 1/8.
 - 6. CWP Rating: 150 psig.
 - 7. Maximum Operating Temperature: 225 deg F.
- C. Automatic Air Vents:
 - 1. Body: Bronze or cast iron.
 - 2. Internal Parts: Nonferrous.
 - 3. Operator: Noncorrosive metal float.
 - 4. Inlet Connection: NPS 1/2.
 - 5. Discharge Connection: NPS 1/4.
 - 6. CWP Rating: 150 psig.
 - 7. Maximum Operating Temperature: 240 deg F.
- D. Expansion Tanks:
 - 1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

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2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- diameter gage glass, and slotted-metal glass guard.

E. Diaphragm or Bladder-Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Diaphragm Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

F. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

G. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig.
3. Maximum Operating Temperature: Up to 300 deg F.

H. Air Purgers:

1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. Maximum Working Pressure: 150 psig.
3. Maximum Operating Temperature: 250 deg F.

2.8 CHEMICAL TREATMENT

- A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
 - 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
- B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.9 HYDRONIC PIPING SPECIALTIES

- A. Y-Pattern Strainers:
 - 1. There shall be strainers in the inlet connections to each water feeder and make-up connection, each water regulating valve, each pump, each vent, and each diaphragm valve. The intention is to protect by strainers, all apparatus of an automatic character whose proper functioning would be interfered with by dirt on that seat, or by scoring of the seat. Strainers shall be SARCO or approved.
 - 2. All strainers in waterlines (including all pump inlets) shall be Y-pattern unless otherwise indicated, set in horizontal (or vertical downward) run of the pipe. Where this is not feasible strainers may be of enlarged-cross-section type. Strainers shall be so arranged as not to "trap" pipes, and to facilitate disconnection and opening-up for cleaning. Unless otherwise indicated, strainers shall be line size.
 - 3. All strainers shall have cast iron, semi-steel or bronze bodies equivalent to ratings specified in "valves" subjected, removable cylindrical or conical screens of monel or stainless steel and suitable and suitable flanges or tapings to connect with the piping they serve. They shall be of such a design as to allow blowing out of accumulated dirt, and to facilitate removal and replacement of a strainer screen, without disconnections of the main piping.
 - 4. Strainer screen perforations shall be 1/32" for steam and mixture of steam and condensate. Water 1/16" perforations for sizes up to 3"; 1/8" perforations for sizes 4" to 12".
 - 5. Provide approved valved and capped dirt blow off connections for each strainer 1-1/2" and larger, with the valve location 6" to 1'-0" below strainer or as directed.
 - 6. Nipples and valves to be full size of strainer blow off tapping. Strainers 1 1/4" and smaller to have capped nipples at least 6" long. For all strainers, the blow out connection is to terminate in an approved manner, at a point where there will be no risk of flooding or damage.
 - 7. All strainers shall be provided with flanged covers for screen removal in lieu of screwed covers for screen removal wherever obtainable.

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8. All strainer screens 8" and above shall be reinforced for the operating conditions.
9. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
10. End Connections: Threaded ends for 2" and smaller; flanged ends for 2-1/2" and larger.
11. CWP Rating: 125 psig.

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

C. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

D. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, 2 1/2" and smaller shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

B. Hot-water heating piping, aboveground, 3" to 10" shall be the following:

1. Schedule 40 grade B seamless Type S steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Condenser-water piping, aboveground, 2 1/2" and smaller shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

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- D. Condenser water piping, 3" to 10" shall be the following
 - 1. Schedule 40 grade B seamless Type S steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- E. Makeup-water piping installed aboveground shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- F. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- G. Condensate-Drain Piping: Type M DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- H. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- I. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 - 2. Outlet: Type L, annealed-temper copper tubing with soldered or flared joints.
- J. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
- K. Secondary water branches from risers to shut-off valves to match riser materials.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install throttling-duty calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

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- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Piping shall be set up and down and offset to meet field conditions and coordination between trades without additional cost. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Pipe work shall conform fully to the following requirements:
 - 1. Provide proper provision for expansion and contraction in all portions of pipe work, to prevent undue strains on piping or apparatus connected therewith. Provide double swings at riser transfers and other offsets wherever possible, to take up expansion. Arrange riser branches to take up motion of riser.
 - 2. Approved bolted, gasketed, flanges (screwed or welded) shall be installed at all apparatus and appurtenances, and wherever else required to permit easy connection and disconnection. Screwed unions with steel faces can be used on piping 1" or less.
 - 3. All piping connections to coils and equipment shall be made with offsets provided with screwed or welded/brazed bolted flanges so arranged that the equipment can be serviced or removed without dismantling the piping.
 - 4. If, after the plant is in operation, any coils or other apparatus are stratified or air bound (by vacuum or pressure), they shall be repiped with approved necessary fittings, air vents, or vacuum breakers at no extra cost. If connection is concealed in furring, floors, or ceilings, this trade shall bear all expenses of tearing up and refinishing construction and finish, leaving same in as good condition as before it was disturbed.
- C. Pitch water piping upward in direction of low to ensure adequate flow without air binding, and to prevent noise and water hammer. Branch connections to mains are to be made in such a manner to prevent air trapping and permit free passage of air. To meet job conditions mains shall set up to maintain headroom, and clear other trades. Provide oversized float operated automatic air vent (with valve & strainer) at all high points particularly at the highest of pints of supply risers. Avoid 90-degree lift se-ups in supply lines by using 45 degree ells. Where 90-degree lifts exceed 12" install automatic air vent in supply lines. All lifts in return lines shall be

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installed with automatic air bents. Pipe outlet of all automatic air vents to an open sight drain if the vent is concealed, or to within two feet of the floor within machine rooms.

- D. Miscellaneous drains, vents and reliefs are to be provided as follows:
1. At all system low points and elsewhere as required to drain system provide 1" drain valves piped between the supply and return risers for riser flushing, and to the condensate drain main. See detail on the drawings.
 2. Miscellaneous drains, vents, reliefs, and overflows from tanks, equipment, piping relief valves, pumps, etc., shall be run to the nearest open sight drain or roof drain. Provide drain valves whenever required for complete drainage of piping, including the system side of all pumps.
 3. Provide domestic water connections from valved outlet to any equipment requiring same.
 4. Provide automatic relief valves set 50 psi below rating pressure of all hot water heating vessels on vessel or in leaving hot water line on vessel side of any valve.
- E. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- H. Install piping to permit valve servicing.
- I. Install piping free of sags and bends.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- M. Install 1" cross connects with ball valve between supply and return piping systems as required for system flushing and pressure testing.
- N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

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- P. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
 - Q. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
 - R. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
 - S. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
 - T. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
 - U. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
 - V. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
 - W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
 - X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
 - Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."
- 3.4 HANGERS AND SUPPORTS
- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
 - B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - C. Install the following pipe attachments:

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1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
 10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
 11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
 12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
 13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
 14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
 15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

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- G. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- H. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

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3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

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- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 CHEMICAL TREATMENT

- A. Perform an analysis by an approved vendor of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:

1. pH: 9.0 to 10.5ph.
2. "P" Alkalinity: 100 to 500 ppm.
3. Boron: 100 to 200 ppm.
4. Chemical Oxygen Demand: Maximum 100 ppm. Modify this value if closed system contains glycol.
5. Corrosion Inhibitor:
 - a. Sodium Nitrate: 1000 to 1500 ppm.
 - b. Molybdate: 200 to 300 ppm.
 - c. Chromate: 200 to 300 ppm.
 - d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
 - e. Chromate Plus Molybdate: 50 to 100 ppm each.
6. Soluble Copper: Maximum 0.20 ppm.
7. Tolyriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum 10 ppm.
8. Total Suspended Solids: Maximum 10 ppm.
9. Ammonia: Maximum 20 ppm
10. Free Caustic Alkalinity: Maximum 20 ppm.
11. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maximum 1000organisms/ml.
 - b. Total Anaerobic Plate Count: Maximum 100 organisms/ml.
 - c. Nitrate Reducers: 100 organisms/ml.
 - d. Sulfate Reducers: Maximum 0 organisms/ml.
 - e. Iron Bacteria: Maximum 0 organisms/ml.

- B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

- C. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.9 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks for four hours.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

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7. Verify lubrication of motors and bearings.

3.10 SYSTEM DRAIN DOWNS

- A. Drain downs existing building systems at times as directed by owner and re-filled as required to meet project schedule.

END OF SECTION

SECTION 232123 - HYDRONIC PUMPS

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.
- B. Vibration and wind criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Noise criteria for this section is referenced in specification section 230548.1. Vendor/manufacturer/contractor is responsible for this section 230548.1 in its entirety.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Close-coupled, in-line centrifugal pumps with ECM Motor.
 - 2. Close-coupled, in-line centrifugal pumps.
 - 3. Base Mounted, end-suction centrifugal pumps.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.
- C. HI : Hydraulic Institute

1.4 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves. Provide written verification that pump motors are sized, selected, and submitted for a non-overloading condition on pump run-out.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

- C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal for each type of pump.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace components of pumps that fail in materials or workmanship within specified warranty period.
1. Extended warranties include parts, labor to replace by installing contractor.
 2. Warranty Period: One (1) year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL PUMPS WITH ECM MOTOR

- A. Manufacturers: Subject to compliance with requirements, provide Bell & Gosset Model Ecocirc XL as manufactured by Xylem or products by one of the manufacturers specified:
1. Armstrong Pumps, Inc.
 2. Bell & Gossett; Div. of ITT Industries.
 3. Grundfos Pumps Corporation.
 4. PACO Pumps.
 5. Peerless Pump; a Member of the Sterling Fluid Systems Group.
 6. Taco, Inc.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump with ECM motor. Designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Components:
1. The pumps shall be a wet rotor inline pump, in cast iron or lead free bronze body construction specifically designed for quiet operation. Suitable standard operations at 230°F and 175 psig working pressure. The pump internals shall be capable of being serviced without disturbing piping connections.
 2. The pump and motor form an integral unit without a mechanical seal.
 3. Pump shall be equipped with a water-tight seal to prevent leakage.
 4. Pump volute shall be of a cast iron design for heating systems or lead free bronze for domestic water systems. The connection style on the cast iron and bronze pumps shall be flanged.
 5. Flange to flange dimension shall be standard Bell & Gosset booster sizes such as 6-3/8", 8-1/2", and 11-1/2". Flange dimensions shall be HVAC industry standard 2 or 4 bolt sizes.
 6. Motor shall be synchronous, permanent-magnet (PM) motor and tested with the pump as one unit. Conventional induction motors will not be acceptable.
 7. Each motor shall have an integrated Electronically Commutated Motor (ECM) tested as one unit by the manufacturer.
 8. Integrated motor protection shall be verified by UL to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).

9. Pump shall have MODBUS or BACnet connections built into the ECM Motor.
10. Analog inputs, such as 0-10V and 4-20mA, are standard inputs built into the ECM Motor.
11. Pumps shall be UL 778 listed and bear the UL Listed Mark for USA and Canada with on board thermal overload protection.
12. Pump manufacturer shall be ISO-9001 certified.
13. Each pump shall be factory performance tested before shipment.

D. Operating Modes:

1. Proportional Pressure – The differential pressure will continuously increase or decrease along a linear curve based on the flow demand.
2. Constant Pressure – The pump maintains a constant differential pressure set by the user at any flow demand until the maximum speed is reached.
3. Constant Speed – The pump maintains a constant speed at any flow rate.
4. Night Set Back – The pump will recognize a 10°C water temperature reduction and will switch to nighttime operation.
5. T-Constant – This control will use a PI algorithm to vary the speed of the pump in order to maintain a constant temperature of the fluid media.
6. Delta-T Constant – This control mode will use a PI algorithm to vary the speed of the pump in order to maintain a constant differential temperature between the built-in temperature sensor and the external temperature sensor.
7. Delta-P-T – This control mode is paired with proportional or constant pressure mode. The nominal differential pressure set point will vary according to the fluid temperature.
8. Delta-P-Delta-T – This control mode is paired with proportional or constant pressure mode. The nominal differential pressure set point will vary according to the differential temperature between the built-in temperature sensor and external temperature sensor.

E. Two Pump Control:

1. Backup – This mode will start the second pump in case of failure to the master pump.
2. Alternate Operation – This mode will run one pump at a time. The working time is switched every 24 hours.
3. Parallel Operation – In this mode, both pumps run simultaneously at the same set point. The master pump determines the behavior of the full system and is able to optimize the performance. To guarantee to required performance with the minimum power consumption, the master pump starts or stops the second pump depending on the head and the flow required.

F. Capacities and Characteristics:

1. Capacity: As scheduled on plans.
2. Total Dynamic Head: As scheduled on plans.
3. Maximum Operating Pressure: 175 psig.
4. Maximum Continuous Operating Temperature: 230 deg. F.

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Pumps, Inc.
2. Bell & Gossett; Div. of ITT Industries.
3. Grundfos Pumps Corporation.
4. TACO, Inc.

B. Description: Factory assembled and –tested, centrifugal, close-coupled, in-line as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally and vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 200 deg. F.

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze or case stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel, with stainless steel shaft sleeve.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Grease lubricated ball bearings.

D. Mounted: Single Speed, with grease-lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 23 Section “Common Motor Requirements for HVAC Equipment”.

E. Capacities and Characteristics:

1. Capacity: As scheduled on plans.
2. Total Dynamic Head: As scheduled on plans.
3. Maximum Operating Pressure: 175 psig.

2.3 BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Pumps, Inc.
2. Bell & Gossett; Div. of ITT Industries.
3. PACO Pumps.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting

with pump and motor shafts mounted horizontal. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 250 deg. F (93 deg. C).

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel, with copper alloy steel shaft sleeve.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Viton bellows and gasket.
5. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

D. Shaft Coupling: Molded rubber insert and interlocking spider cable of absorbing vibration.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Single speed, with permanently lubricated or grease-lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

H. Capacities and Characteristics:

1. Capacity: As scheduled on plans.
2. Total Dynamic Head: As scheduled on plans.
3. Maximum Operating Pressure: 175 psig.
4. Maximum Continuous Operating Temperature: 230 deg. F.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 PUMP INSTALLATION

- A. Comply with HI 1.4, HI 2.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Install continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

- E. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. First paragraph and subparagraphs below are for base-mounted pumps that require design considerations for size, mass, and isolation from other structural members. A foundation is not an inertia base. Design and detail inertia bases on Drawings.
- F. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
 - 1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches (19 to 38 mm) between pump base and foundation for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.
- G. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.4 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with non-shrink, non-metallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install triple-duty valve on discharge side of pumps.
- F. Install Y-type strainer on inline pump inlet and suction diffuser on inlet of end suction pumps and shutoff valve on suction side of all pumps.

- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.
- I. Install check valve and gate or ball valve on each condensate pump unit discharge.
- J. Install electrical connections for power, controls, and devices.
- K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Provide laser alignment of pumps.
 - 3. Check piping connections for tightness.
 - 4. Clean strainers on suction piping.
 - 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 7. Start motor.
 - 8. Open discharge valve slowly.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 232123

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SECTION 232500

HVAC WATER TREATMENT

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.
- B. Vibration and wind criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Noise criteria for this section is referenced in specification section 230548.1. Vendor/manufacturer/contractor is responsible for this section 230548.1 in its entirety.

1.2 SUMMARY

- A. This Section includes the following HVAC water-treatment systems:
 - 1. Evaporative cooling system chemical feeders.
 - 2. Evaporative cooling system bleed controller & valve.
 - 3. Bypass chemical-feed/side stream filtration equipment.
 - 4. Corrosion coupon racks.
 - 5. HVAC water treatment chemicals.
 - 6. Condenser Water Closed Loop Freeze Protection.
 - 7. Galvanize passivation (white rust prevention).
 - 8. Pipe flush & passivation.
 - 9. Water treatment test kits and equipment.

1.3 DEFINITIONS

- A. EEPROM: Electrically erasable, programmable read-only memory.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- C. RO: Reverse osmosis.

- D. TDS: Total dissolved solids.
- E. UV: Ultraviolet.

1.4 PERFORMANCE REQUIREMENTS

- A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- C. Closed hydronic systems, including hot-water, heating chilled, water dual-temperature water and closed condenser water loop with glycol, shall have the following water qualities:
 - 1. pH: 8.0 - 10.5
 - 2. Fe (Iron): 1.0 ppm max
 - 3. Cu (copper): 0.2 ppm max
 - 4. Condenser Loop Freeze Protection: The Condenser closed loop shall be filled with 40% by weight inhibited propylene glycol heat transfer fluid designed for use in hydronic systems. The inhibitor system shall be designed to protect metals commonly found in residential and commercial installations such as brass, copper, solder, steel, and cast iron. The formula should also include a dye, for leak detection, and an antifoam to minimize foaming during service. The product at 40% should provide freeze protection to -8 degrees F. Houghton SAFE-T-THERM or equivalent.
- D. Open hydronic systems, including fluid-cooler spray water, shall have the following water qualities:
 - 1. Conductivity: 1000 - 1300 μ mohs
 - 2. pH: 7.5 - 8.9
 - 3. Hardness: 300 ppm max
 - 4. Fe (Iron): Cycled amount + 1.0 ppm
 - 5. Cu (copper): 0.2 max
 - 6. Organophosphonate : 4 - 20 ppm
 - 7. Mo⁺⁶(molybdate): 0.9 to 1.5 ppm
 - 8. Tolytriazole (TTA): 2 ppm minimum
 - 9. Microbiological Limits:
 - a. Bacteria (cfu/ml): Less than 1×10^3 colonies per ml

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10. Open Recirculatory System corrosion/deposit control: Molybdate/Azole/organo-phosphonate/polymer blend. (Drew 5382 or equivalent). Open Recirculatory System microbiocide: Drewbrom® One L
11. All biocides must have current EPA registrations and be registered for use in NJ State with label claims supporting the intended use.

E. Passivation for Galvanized Steel: For the first 60 days of operation.

1. pH: Maintain a value within 7 to 8.
2. Orthophosphate: Maintain a value within 100 to 300 ppm.
3. Total Alkalinity: Maintain a value within 100 to 250 ppm.
4. Total Hardness: 100 to 400.

1.5 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Chemical solution tanks.
2. Chemical test equipment.
3. Chemical material safety data sheets.
4. Multimedia filters.
5. Bag- or cartridge-type filters.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For sensors, injection pumps, water filtration units, and controllers to include in emergency, operation, and maintenance manuals.

E. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

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1.6 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- B. Manufacturer: Company specializing in manufacturing water treatment chemicals for use in HVAC systems with minimum ten years documented experience. Company shall have local representatives (within 50 miles of project site) with water analysis laboratories and full time service personnel.
- C. The water treatment company shall meet the following minimum requirements:
 - 1. It shall be regularly engaged in this type of work and service and shall have specialists with at least five years experience in the cleaning and chemical treatment of systems of similar size capacity, and shall be in active responsible charge of all treatment work. Written documentation must be provided for approval.
 - 2. It shall either operate or have access to a laboratory equipped to analyze samples in accordance with the standard methods of the American Water Works Association and the American Society for Testing Materials.
 - 3. The water treatment service company's primary service representative for the project must have current NJ State pesticide applicator supervisor's certification.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping heating, hot-water piping condenser-water piping XXX Cobler spray system and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
 - 1. Initial water analysis and HVAC water-treatment recommendations.
 - 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 - 3. Twice Monthly site visits for cooling towers.
 - 4. Quarterly site visits for closed systems once 2 months of constant treatment levels within prescribed control range can be documented.
 - 5. Customer report charts and log sheets.
 - 6. Laboratory technical analysis.

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7. Analyses and reports of all chemical items concerning safety and compliance with government regulations.
- B. Provide service and all required chemicals for initial cleaning, test equipment and all chemicals required for start-up and the one year period during which service is rendered. Provide laboratory and technical assistance services for the service period.
- C. All service visits shall be confirmed in writing to the Owner so that a complete record of service activities is available for examination by the Owner and Engineer. Submit two copies of each report to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by Ashland Water Technologies, Nalco or approved equal.

2.2 CHEMICAL-FEED EQUIPMENT

- A. Bag filter housing bypass Feeder & side stream filter: as scheduled on plans Filtration Systems NC-122 Carbon steel bag filter housing rated for 30 GPM, 150 PSI & (50) P-001-P2-IP one micron filter bags. The filter housing shall be installed using the pressure differential across the closed loop recirculating pumps to force water through filter housing for side stream filtration & slug chemical additions.
- B. Self-contained dual chemical feed station comprised of liquid chemical feed stations to two (2) evaporative cooling system chemical water treatment feed Designed for outdoor duty so that it can be mounted directly onto the process fluid cooler.
- C. Bleed Controller: To facilitate the control of cooling tower(s) blow down. Two (2) OnGuard B controller shall be installed on each cooling tower with remote conductivity probe and flow switch flow assembly.

Features:

- 0-9,900 μ S conductivity control range
- Large graphical display

- Battery backup
- High Low alarm w/ output relay
- Four inhibitor feed modes
- Dual biocide pump output
- Input for two water meters (make-up & blow down)
- NEMA 4X enclosure

D. Blowdown Valve: Belimo ½" or ¾" spring return motorized ball valve, with 120 VAC, 60 Hz, 1 ph actuator NEMA 4X rated for outdoor duty.

E. Item-Quantity – As scheduled on plans

1. SolvAll-10 Solid Chemical Feeder - 4
2. Pulsafeeder Microvision Model# MVS-1XF controller - 2
3. Belimo Nema 4X ¾" moroized bleed valve, power open/spring close - 2
4. Filtration Systems NC-122 housing - 3
5. Filtration Systems P-001-P2 one micron filter bags - 50

2.3 STAINLESS-STEEL PIPES AND FITTINGS

A. Stainless-Steel Tubing: Comply with ASTM A 269, Type 316.

B. Stainless-Steel Fittings: Complying with ASTM A 815/A 815M, Type 316, Grade WP-S.

C. Two-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig (1725-kPa) SWP and 600-psig (4140-kPa) CWP ratings.

D. Three-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, threaded body design with adjustable stem packing, threaded ends, and 150-psig (1035-kPa) SWP and 600-psig (4140-kPa) CWP rating.

2.4 CHEMICAL TREATMENT TEST EQUIPMENT

A. Conductivity/pH tester: MYRON L Model 6P, conductivity, pH, ORP multimeter.

B. Test Kit: cooling tower test kit with molybdate, phosphonate, total hardness, m-alkalinity, nitrite and chloride tests.

2.5 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install water testing equipment on wall near water chemical application equipment.
- C. Install interconnecting control wiring for chemical treatment controls and sensors.
- D. Mount sensors and injectors in piping circuits.
- E. Bypass Feeders: Install in closed hydronic systems, including hot-water heating chilled water dual-temperature water closed condenser water and glycol cooling, and equipped with the following:
 - 1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 2. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 3. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 - 4. Install a swing check on inlet after the isolation valve.

3.3 PIPE FLUSH & PASSIVATION PROCEDURES

- A. Black Iron Pipe Cleaning Procedure

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1. Introduce a heavy domestic water flush. Ideally, maintain a fluid velocity of 3 to 8 ft/sec. Continue to flush until influent parameters (pH, conductivity, Fe, Cu) are similar to effluent values.
2. Install pump and recovery equipment to create a circulator loop covering the entire length of pipe.
3. Once system is full of clean water and is circulating, add an alkaline-based, low molecular weight polymer to remove any flux or oil and grease. Add sodium hydroxide to raise the pH to 11.
4. After recirculation, completely drain piping without introducing city water.
5. When drained, leave bottom valve open and flush pipes with city water. Flush until pH is around 6.0 - 8.0.
6. When flushing is complete add molybdenum/TTA-based corrosion inhibitor to a minimum of 100 ppm Mo+6 and circulate to mix. Leave pipes full of treated water.

B. Copper Piping Cleaning Procedures

1. Repeat steps 1, 2 for black iron piping.
2. Once system is full of clean water and is circulating, add an alkaline-based, low molecular weight polymer to remove any flux or oil and grease. Add sodium hydroxide to raise the pH to 10. Add tolyltriazole to 50 ppm and circulate for 1 - 2 hours, maintaining noted parameters.
3. After recirculation, completely drain piping without introducing city water.
4. When drained, leave bottom valve open and flush pipes with city water. Flush until pH is around 6.0 - 8.0.
5. When flushing is complete add molybdenum/TTA-based corrosion inhibitor to a minimum of 10 ppm TTA and circulate to mix. Leave pipes full of treated water.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."
- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in make-up water connections to potable-water systems.

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- F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. **Tests and Inspections:**
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
 - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
 - 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 - 5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 - 8. Repair leaks and defects with new materials and retest piping until no leaks exist.

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- D. Remove and replace malfunctioning units and retest as specified above.
- E. Comply with ASTM D 3370 and with the following standards:
 - 1. Acidity and Alkalinity: ASTM D 1067.
 - 2. Iron: ASTM D 1068.
 - 3. Water Hardness: ASTM D 1126.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

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SECTION 233113

DUCTWORK

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. Sheet metal ductwork and fittings.
- 2. Sheet metal materials.
- 3. Duct liner.
- 4. Sealants and gaskets.
- 5. Hangers and supports.
- 6. Seismic-restraint devices.

B. Related Sections:

- 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
- 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints for life safety & Smoke Purge systems and seismic loads and stresses within limits and under conditions

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described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7, SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

- B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work. All drawings shall be prepared in AutoCAD (latest version) at a scale no smaller than 3/8"-1'-0".
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of bottom of ducts from finished floor.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, fire dampers, fire smoke dampers, automatic louver dampers, louvers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
13. All air handlers, A/C units, fans, terminal units, filters and equipment with required service and clearance areas. Provide a minimum of 2 elevations at each air handler, air conditioning unit.

- C. Delegated-Design Submittal:

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1. Sheet metal thicknesses.
 2. Joint and seam construction and sealing.
 3. Reinforcement details and spacing.
 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation] for selecting hangers and supports and seismic restraints.
- D. Coordination Drawings: Plans, drawn to scale no smaller than 3/8"-1'-0" in AutoCAD (latest version), on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
 - g. Work of other trades including but not limited to sprinkler, plumbing, electrical and mechanical.
- E. Welding certificates.
- F. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:

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1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."
- E. Mockups:
1. Before installing duct systems, build mockups representing static-pressure classes in excess of 2-inch wg. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - a. Five transverse joints.
 - b. One access door(s).
 - c. Two typical branch connections, each with at least one elbow.
 - d. Two typical flexible duct or flexible-connector connections for each duct and apparatus.
 - e. One 90-degree turn(s) with turning vanes.
 - f. One fire damper(s).
 - g. Perform leakage tests specified in "Field Quality Control" Article. Revise mockup construction and perform additional tests as required to achieve specified minimum acceptable results.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials utilized in the construction of the ductwork including but not limited to adhesives, sealant, liner, fasteners, tapes, etc., shall have a fire and smoke hazard rating as tested by Procedure ASTM E84, NFPA 255 and UL 723 not exceeding:

Flame Spread	25
Smoke Developed	50

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1. All materials shall be submitted for review. It shall be certified in writing that all products to be used on this Project comply with above criteria. All products or their shipping cartons shall bear labels indicating that flame and smoke ratings do not exceed above requirements.
2. Duct sizes including internally lined ducts indicated on the Contract are the clear inside dimensions. The actual sheet metal dimension shall be increased for the thickness of the liner.
3. The interior surfaces of all ductwork shall be smooth. No sheet metal parts, tabs, angles or anything else may project into the air ducts for any reason unless specified to do so. All seams and joints shall be external unless otherwise shown on the Drawings.
4. After shop fabrication but prior to delivery to site, clean all ductwork. In addition, all air handling units and supply and exhaust ductwork shall be cleaned and sealed at the shop. Seal shall remain in place until final assembly in field.
5. The interior of all ductwork shall be maintained clean and free of dust, debris, water and foreign materials prior to first use and at substantial completion. If necessary the Subcontractor shall clean the ductwork and remove the internal debris and foreign material. All fans shall be operated and all debris and foreign material shall be removed from the fan casing and inlet and discharge ducts. The interior of ductwork and airside equipment shall be clean at the time of final Review by the Engineer.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" (latest edition) based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints 2" to 22": Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Transverse Joints Above 22": Ductwork above 22" in width shall be joined at the transverse joints with prefabricated galvanized Ductmate sections, Ward Industries, Inc. or with fabricated T-24 Type flanged transverse joints by Engle, TDF or Lockformer Company TDC with bolted corners, gaskets, sealant, constructed and reinforced in accordance with 1995 SMACNA Manual. Plastic joint clips are not acceptable. Flanged and prefabricated joints by different clips are not acceptable. Flanged and prefabricated joints by different manufacturers shall not be joined. Intermediate reinforcement for all such joints shall be in accordance with 1995 SMACNA Manual, Table 1-10 and 1-10M and shall not exceed 1-1/2" in overall height on duct widths less than 96" and 2" in overall height on duct widths greater than 96". At the Subcontractor's option Engel Industries roll formed zee bars may be used if the installation

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complies with the stiffness rating in the 1995 SMACNA Manual Table 1-10. At the Subcontractor's option Condulock or Studlock internal bracing systems may be used in accordance with the 1995 SMACNA Manual requirements for tie rod installations. Conduit will be placed at the middle and at each end of the 5-foot duct section.

- D. Longitudinal Seams: Select "Pittsburgh Lock" seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate with "Pittsburgh lock seam" according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Ductwork shall be constructed of "lock forming quality" galvanized steel of the gauge thickness and reinforcement listed in the 1995 SMACNA Manual for the pressure class indicated hereinafter with gauge tolerances as listed in Appendix A.2 of the 1995 SMACNA Manual except that ductwork passing above one hour rated corridors shall not be less than the minimum gauge required by the UL Fire Resistive Directory. All steel sheets shall comply with ASTM 924/224-97a and ASTM A 653/A653M-98 with a hot dipped galvanized coating weight that complies with at least the G-65 Section of ASTM A653. The subcontractor shall certify in writing to the Engineer that the sheet metal furnished for this Project is suitable for the service intended and complies with the requirements herein. Prior to ductwork fabrication, the Subcontractor shall submit to the Engineer for review complete certifications and data (in the English language) on all sheet metal materials manufactured outside the United States.

2.3 KITCHEN EXHAUST DUCTWORK

- A. All kitchen range exhaust ductwork shall be constructed of #10 gauge black iron for horizontal ducts and #10 gauge for vertical ducts, with welded seams. The exterior of all kitchen range exhaust ducts shall have 1.5" x 1.5" x 1/8" welded angles, punched for securing block insulation. All seams and joints shall have a continuous external weld as per NFPA 96. Where kitchen range exhaust duct risers pass vertically through floors of the building, provide angle clips welded to the duct of required sizes to support the weight of the riser sections on the building's structural steel in shafts to properly support exhaust ductwork from building construction. Provide 18" x 18" gasketed and bolted access doors on side of horizontal duct at 15' spacing, and a 24" x 24" gasketed and bolted access door at the top of the riser. All horizontal ducts shall be pitched back to hoods 1/4" per foot or maximum pitch attainable. This

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trade shall drill or cut all required openings as required by the duct extinguishing system and as coordinated with the trade supplying the extinguishing spray heads.

B. All kitchen and range exhaust ductwork to be insulated with 2" thick high temperature insulation as follows:

1. High temperature insulation shall be 11lbs per cubic feet density molded hydrous calcium silicate with a maximum K factor of 0.42 at 200°F. Mean temperature.
2. Insulation shall be securely wired in place with copper clad wire or galvanized steel bands (1/2" x .015") on 12" centers.
3. All joints and voids of insulation shall be filled and pointed with mineral wool cement.
4. Over the insulation apply 1" galvanized wire netting secured to the bands or wires and pulled down tight. The apply 1/4" thick coat of insulating and finishing cement trowelled to a smooth finish. This applies to both exposed and concealed work.
5. For kitchen exhaust ducts exposed in finished spaces cover the cement finish with glass cloth set in adhesive.
6. Sections of equipment requiring periodic servicing shall be insulated with aluminum covers lined with the same thickness of material as the adjoining insulation.

C. Waterproof Exhaust Ductwork

1. All exhaust ductwork from dishwashers, pot sinks, ovens or other kitchen apparatus emitting heat or vapor (other than range hood exhaust) shall be constructed of stainless steel (using S.M.A.C.N.A. standards) with soldered joints and made watertight. This includes for systems without range hood exhaust fan to the discharge air louver. The ducts shall pitch back to the dishwasher from the vertical riser or where the run of duct is too long shall change pitch to drain to the bottom of the riser. Where ducts leave shaft to enter the exhaust fan they shall also be pitched to a low point and run to the nearest drain. This trade shall be help-responsible to provide watertight and drained system regard less of the quantity of steam or water vapor leaving the equipment.

D. Exhaust ductwork for dishwashers and waterproof exhaust systems to be insulated with 1.5" thick flexible duct insulation with vapor barriers as follows:

1. Flexible duct insulation shall be 1 lb per cubic feet density glass fiber with a maximum K factor of 0.29 at 75°F. Mean temperatures, with reinforced foil-faced, flame resistant Kraft vapor barrier.
2. Insulation shall be secured with duct adhesive. All joints shall be sealed by adhering a 2" sealing lap at all joints with vapor barrier jacket applied with vapor barrier adhesive. Insulation shall then be fastened with 16 gauge copper-clad wire or fiberglass cord on 12" centers on ducts over 24" wide, welded pins & clips shall be used on the underside.

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3. Exposed round shall have a white vinyl reinforced foil vapor barrier. Application same except wires shall be omitted and blanket be secured by stapling 2" longitudinal laps. Staples shall be coated with vapor barrier coating.

2.4 DUCTWORK AT EXTERIOR LOUVERS

- A. All intake and discharge ductwork connected to exterior louvers shall be constructed of stainless steel (using SMACNA standards) with soldered joints and made watertight. The ducts shall pitch back to drain out through the louver. Where the run of duct is too long, change pitch to drain to the bottom of the riser or plenum. Extend 1-1/2" copper drain to nearest indirect waste. This trade shall be held responsible to provide watertight and drained system.
- B. Ductwork connected to exterior louvers to be insulated with 2" thick flexible duct insulation with vapor barriers as follows:
 1. Flexible duct insulation shall be 1 lb per cubic feet density glass fiber with a maximum K factor of 0.29 at 75°F. Mean temperatures, with reinforced foil-faced, flame resistant Kraft vapor barrier.
 2. Insulation shall be secured with duct adhesive. All joints shall be sealed by adhering a 2" sealing lap at all joints with vapor barrier jacket applied with vapor barrier adhesive. Insulation shall then be fastened with 16 gauge copper-clad wire or fiberglass cord on 12" centers on ducts over 24" wide, welded pins & clips shall be used on the underside.
- C. Provide double wall insulated access doors at each louver and all A.L.D.S.
- D. All unused portions of louvers shall be blanked-off with double wall stainless steel internally insulated with minimum 2" rigid board insulation under this Section of Work.

2.5 DUCTWORK AT HUMIDIFIERS

- A. All ductwork two feet upstream and ten feet downstream of humidifiers shall be constructed of stainless steel (using SMACNA standards) with soldered joints and made watertight. The ducts shall pitch back to a drain 12" downstream of humidifier. This trade shall be help-responsible to provide watertight and drained system regard less of the quantity of steam or water vapor leaving the equipment.
- B. Provide double wall insulated access doors upstream and downstream of humidifiers.

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2.6 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab, Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 48" in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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2.7 ROUND AND FLEXIBLE DUCTWORK

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Clevaform Type DB.
 - b. Flexmaster.
 - c. Hart & Cooley.
 - d. Thermaflex.
- B. Flexible duct for connections shall be rated for a maximum pressure 4" water column positive and 2" water column maximum negative pressure and 6000 FPM maximum velocity and Listed by Underwriters Laboratories, Inc. under UL Standard 181 as Class I air duct and complying with NFPA Standards 90A and 90B and have an 8.0 per ASTM C-518. Flexible duct shall be factory made and composed of an inner duct of woven and coated fiberglass providing an air seal and permanently bonded to coated steel wire helix, a fiberglass providing an air seal and permanently bonded to coated steel wire helix, a fiberglass insulating blanket, and low permeability outer vapor barrier of fiberglass-reinforced metallized film laminate with a minimum R value of 8.0 per ASTM C-518.
- C. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible.
- D. Flexible ducts shall be secured with stainless steel clamps or 100% nylon self-locking clamps. Provide (1) clamp for inner core and (1) clamp for outer jacket.
- E. Flexible ductwork shall only be used where indicated on plans and shall not be used for making offsets to diffusers, register or grilles.

2.8 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

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- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
 - 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

- D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

- E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

- F. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

- G. Factory- or Shop-Applied Antimicrobial Coating
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
 - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 5. Shop-Applied Coating Color: White.
 - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

- H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

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- I. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.9 DUCT LINER

- A. Duct lining shall be roll form, 1/2" or 1" or 2", as called out in the specifications. It shall be installed on all interior surfaces of sheet metal ductwork where specified or shown on the drawings.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville Permacote Linacoustic or comparable product by one of the following:

- a. CertainTeed Corporation; Insulation Group.
- b. Knauf Insulation.
- c. Owens Corning.

2. Maximum Thermal Conductivity

- a. Type I, Flexible: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

- a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Insulation Pins and Washers

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

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1. Adhere a single layer of indicated thickness of duct liner with at least 100 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. All transverse and longitudinal abutting edges of duct lining shall be sealed and lapped 3" with a heavy coat of adhesive, in accordance with the manufacturer's recommendations.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges, VAV box and fan powered box discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
 - d. Fire damper, fire smoke damper, automatic louver dampers.
 - e. Access doors
9. Where indicated on plans or specifications provide perforated sheet metal liner. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with build outs attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build outs (metal hat sections) or other build out means are optional; when used, secure build outs to duct walls with bolts, screws, rivets, or welds.
11. Duct lining shall conform to ASTM C1071 standard "Thermal and Acoustical Insulation" and have the following minimum sound absorption coefficients when tested in accordance with ASTM C423 and E795 procedures mounting type "A":

Thickness	Octave Band Center Frequency, HZ						
	125	250	500	1000	2000	4000	NRC
1" Thick	0.09	0.31	0.67	0.91	1.01	1.00	0.70

12. Extent of ductwork sound linings:
 1. All supply and return ducts: For air conditioning and non-guest room heat pump units: 1" Thick.
 2. Upstream and downstream of exhaust fans for minimum distance of 20'-0", (6 m). Exceptions: ducts for fume hoods, biohazard, wet exhaust, dust collector: 1" thick.
 3. All transfer ducts: 1" thick.
 4. Ductwork downstream of VAV and guestroom heat pump units:
 - a. From discharge 10'-0" downstream: 1" thick.
 - b. From 10'-0" downstream to last outlet: 1/2" thick.
 5. Toilet exhaust risers: 1/2" thick.

2.10 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Solvent-Based Joint and Seam Sealant:

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1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.11 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

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- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct" or as detailed on plans.
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.12 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti Corp.
 - 4. Kinetics Noise Control.
 - 5. Loos & Co.; Cableware Division.
 - 6. Mason Industries.
 - 7. TOLCO; a brand of NIBCO INC.
 - 8. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

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- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.12 ACCESS DOORS IN SHEETMETAL WORK

- A. This Contractor shall provide suitable access doors and frames to permit inspections, operation and maintenance of all valves, all coils including reheat coils, controls, fire dampers, air monitors where applicable, automatic or motorized dampers, filters, bearings, traps, or other apparatus concealed behind the sheet metal work. All such doors shall be of double construction of not less than No. 20 gauge sheet metal and shall have sponge rubber gaskets around their entire perimeter. Doors in insulated ducts or insulated casings shall have rigid fiberglass insulation between the metal panels.
- B. All access doors in sheet metal ducts shall be hung on heavy flat hinges and shall be secured in the closed position by means of cast zinc clinching type latches. Where space conditions preclude hinges, use four heavy window type latches and provide 4'-0" permanent cable attaching door to ductwork. Doors into ducts shall in general not be small than 18" x 18" except for access door to fire dampers which will depend on size of fire damper. Submit samples for approval.
- C. In no case shall access to any items of equipment requiring inspections, adjustment, or servicing require the removal of nuts, bolts, screws, wing nuts, wedges, or any other screwed or loose device.
- D. Each sheet metal chamber shall have access doors for access to all parts of the system. Doors shall be fitted with cast zinc door latches, two per door. Latches shall be operable from both sides of casing. Hinges shall be extra heavy, zinc plated hinges, minimum of two per door. The doors shall be felted or provided with rubber gaskets so as to make them airtight. The doors shall be made with inner and outer shells 2 inches apart so that they may be properly insulated and properly operated. Doors shall be a minimum size of 20" x 48".

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PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures, or over electric panels.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

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3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.
- F. Ductwork to be "pickled" or prime for acceptance of final painting by others.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts and as additionally indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

- A. All non-welded ducts to be sealed to Seal Class A as described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

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- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.
 - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.

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- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Provide galvanized steel primer on all exposed ducts. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

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- B. Leakage Tests: To be performed as specified in Division 23 "Testing, Adjusting and Balancing."
 - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 2. Test for leaks before applying external insulation.
 - 3. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 4. Give seven days' advance notice for testing.

 - C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg /100 cm².

 - D. Duct system will be considered defective if it does not pass tests and inspections.

 - E. Prepare test and inspection reports.
- 3.10 DUCT CLEANING
- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

 - B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.

 - C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.

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2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 6. Provide drainage and cleanup for wash-down procedures.
 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

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3.11 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.
- B. Supply Ducts:
 - 1. Ducts Connected to Guest Room Heat Pump Units, downstream of VAV boxes and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - 2. Ducts Connected to Constant-Volume Air-Conditioning and Heat Pump Units:
 - a. Pressure Class: Positive 2-inch wg.
 - 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
 - 4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 2-inch wg.
- C. Return Ducts:
 - 1. Ducts Connected to Guest room Heat Pump Units, downstream of VAV boxes and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - 2. Ducts Connected to Air-Handling Units
 - a. Pressure Class: Positive or negative 3-inch wg.
 - 3. Ducts Connected to Equipment Not Listed Above

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- a. Pressure Class: Positive or negative 2-inch wg.

D. Exhaust Ducts

- 1. Ducts connected to fans for smoke exhausting.
 - a. Pressure Class: Negative 6-inch wg.
- 2. Ducts Connected to Fans for Toilet Exhausts
 - a. Pressure Class: Negative 2-inch wg.
- 3. Ducts Connected to Stair and Elevator Shaft Pressurization
 - a. Pressure Class: Positive or negative 3-inch wg.
- 4. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless-steel sheet, No. 3 finish.
 - b. Concealed: Carbon-steel sheet.
 - c. Welded seams and joints.
 - d. Pressure Class: Positive or negative 4-inch wg.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
- 5. Ducts Connected to Dishwasher Hoods
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 3 finish.
 - c. Concealed: No. 2D finish.
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - e. Pressure Class: Positive or negative 3-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
- 6. Ducts Connected to Equipment Not Listed Above
 - a. Pressure Class: Positive or negative 3-inch wg.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts

- 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units
 - a. Pressure Class: Positive or negative 2-inch wg.
- 2. Ducts Connected to Air-Handling Units

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- a. Pressure Class: Positive or negative 3-inch wg.

F. Intermediate Reinforcement

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. PVC-Coated Ducts
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
3. Stainless-Steel Ducts
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
4. Aluminum Ducts: Aluminum.

G. Double-Wall Duct Interstitial Insulation

1. Supply Air Ducts: 1 inch thick.
2. Return Air Ducts: 1 inch thick.
3. Exhaust Air Ducts: 1 inch thick.

H. Elbow Configuration

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or lower
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or higher

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- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
- a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam Welded.
- I. Branch Configuration
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

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2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

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SECTION 233300

AIR DUCT ACCESSORIES

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.
- B. Vibration seismic and wind criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Noise criteria for this section is referenced in specification section 230548.1. Vendor/manufacturer/contractor is responsible for this section 230548.1 in its entirety.

1.2 SUMMARY

A. Section includes:

- 1. Manual volume dampers.
- 2. Control dampers.
- 3. Fire dampers.
- 4. Combination fire and smoke dampers.
- 5. Flange connectors.
- 6. Duct silencers.
- 7. Turning vanes.
- 8. Remote damper operators.
- 9. Duct-mounted access doors.
- 10. Flexible connectors.
- 11. Duct accessory hardware.

B. Related Sections:

- 1. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

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1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Duct security bars.
 - f. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

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1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - d. Stops on head and sill.
 5. Blades:
 - a. Single blade for 11" high and under.
 - b. Opposed-blade design 12" high and above.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
 - e. Maximum 48" long.
 - f. All blades to be interconnected to act in unison.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Galvanized steel.
 9. Provide locking quadrant of sufficient size and design to securely hold the damper sections and blade linkage hardware.
 10. Damper shafts shall be marked to indicate damper position.
 11. Dampers shall be sized at 100% free area of duct.
- B. Standard, Aluminum, Manual Volume Dampers

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 2. Standard leakage rating, with linkage outside airstream.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Single blade 11" high and under
 - b. Parallel- or opposed-blade design 12" high and above.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 - f. Maximum 48" long.
 - g. All blades to be interconnected to act in unison.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Aluminum.
 9. Provide locking quadrant of sufficient size and design to securely hold the damper sections and blade linkage hardware.
 10. Damper shafts shall be marked to indicate damper position.
 11. Dampers shall be sized at 100% free area of duct.
- C. Low-Leakage, Steel, Manual Volume Dampers:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames:
 - a. Hat shaped.
 - b. Galvanized-steel channels, 0.064 inch thick.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Single blade 11" high and under.
 - b. Parallel- or opposed-blade design 12" high and above.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel, 0.064 inch thick.
 - e. Maximum 48" long.
 - f. All blades to be interconnected to act in unison.
6. Blade Axles: Galvanized steel.
7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Blade Seals: Neoprene.
9. Jamb Seals: Cambered stainless steel or aluminum.
10. Tie Bars and Brackets: Galvanized steel or Aluminum.

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11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
 12. Dampers shall be sized at 100% free area of duct.
- D. Low-Leakage, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Single blade.
 - b. Parallel- or opposed-blade design.
 - c. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 - e. Galvanized-steel, 0.064 inch thick.
 - f. Maximum 48" long.
 6. Blade Axles: Stainless steel.
 7. Bearings:
 - a. Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

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8. Blade Seals: Neoprene.
9. Jamb Seals: Cambered aluminum.
10. Tie Bars and Brackets: Aluminum.
11. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
12. Dampers shall be sized at 100%. Free area of duct.

E. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. Lloyd Industries, Inc.
8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
9. McGill AirFlow LLC.
10. METALAIR, Inc.
11. Metal Form Manufacturing, Inc.
12. Nailor Industries Inc.

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13. NCA Manufacturing, Inc.
 14. Ruskin Company.
 15. Vent Products Company, Inc.
 16. Young Regulator Company.
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage. Arrange linkages for maximum 32 square feet of damper per actuator.
- C. Frames:
1. Hat shaped.
 2. Galvanized-steel channels, 0.064 inch thick.
 3. Mitered and welded corners.
- D. Blades:
1. Multiple blade with maximum blade width of 8 inches.
 2. Parallel- and opposed-blade design.
 3. Galvanized steel.
 4. 0.064 inch thick.
 5. Blade Edging: Closed-cell neoprene edging.
 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
 7. Maximum 46" long.
- E. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
1. Stainless-steel sleeve.
 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 3. Thrust bearings at each end of every blade.
- 2.4 FIRE DAMPERS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.

2. Arrow United Industries; a division of Mestek, Inc.
 3. Cesco Products; a division of Mestek, Inc.
 4. Greenheck Fan Corporation.
 5. McGill AirFlow LLC.
 6. METALAIRE, Inc.
 7. Nailor Industries Inc.
 8. NCA Manufacturing, Inc.
 9. PHL, Inc.
 10. Pottorff; a division of PCI Industries, Inc.
 11. Prefco; Perfect Air Control, Inc.
 12. Ruskin Company.
 13. Vent Products Company, Inc.
 14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL. And authorities having jurisdiction.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors. Maximum 6" wide blades.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

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- K. Each damper shall be operationally tested by pulling trip linkage after the installation is complete. A written certificate shall be issued by the Subcontractor to the Owner and Engineer stating the identification of damper as to location, date tested, names and signatures of testing personnel.

2.5 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
 - 6. Pottorff.
- B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours as required.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- H. Smoke Detector: External, furnished by Electrical contractor for field mounting under this scope of work.
- I. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- J. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- K. Leakage: Class I.
- L. Rated pressure and velocity to exceed design airflow conditions.

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- M. Mounting Sleeve: Factory-installed, 0.052-inch- thick (or as required by code), galvanized sheet steel; length to suit wall or floor application.
- N. Master control panel for use in dynamic smoke-management systems.
- O. Damper Motors: Modulating or two-position action.
- P. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC." & Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- Q. Accessories:
 - 1. Auxiliary switches for signaling, fan control or position indication.
 - 2. Momentary test switch, damper mounted.
 - 3. Disconnect switch.
 - 4. Contacts for fire alarm system open/close operation, damper position indication (open/closed).
 - 5. Contacts for damper open/close operation by Fire Alarm System
 - 6. UL listed reopenable operator, capable of override at minimum 250 deg. F.
 - 7. Damper position indicating package to remotely indicate damper position (open/closed) by BMS.

2.6 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.7 DUCT SILENCERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Industrial Noise Control, Inc.
 2. McGill AirFlow LLC.
 3. Ruskin Company.
 4. Vibro-Acoustics.
 5. Industrial Acoustics Corporation.
- B. General Requirements:
1. Factory fabricated.
 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- C. Shape:
1. Rectangular straight with splitters or baffles.
 2. Round straight with center bodies or pods.
 3. Rectangular elbow with splitters or baffles.
 4. Round elbow with center bodies or pods.
 5. Rectangular transitional with splitters or baffles.

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- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G60, galvanized sheet steel, 22 gauge 0.034 inch thick.
- E. Round Silencer Outer Casing: ASTM A 653/A 653M, G60, galvanized sheet steel.
 - 1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
 - 2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
 - 3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inch thick.
 - 4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.
- F. Inner Casing and Baffles: ASTM A 653/A 653M, G60 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch- diameter perforations.
- G. Special Construction:
 - 1. Suitable for outdoor use.
 - 2. High transmission loss.
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- I. Principal Sound-Absorbing Mechanism:
 - 1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 - 2. Dissipative type with fill material.
 - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression Moisture-proof nonfibrous material.
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
 - 3. Lining: Mylar in all ducts with outside air or vapor laden exhaust.
- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 - 1. Lock form and seal or continuously weld joints.
 - 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 - 3. Reinforcement: Cross or trapeze angles for rigid suspension.
- K. Accessories:
 - 1. Factory-installed end caps to prevent contamination during shipping.
 - 2. Removable splitters.

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3. Airflow measuring devices.

L. Source Quality Control: Test according to ASTM E 477.

1. Testing of mockups to be witnessed by Architect, Owner and acoustic consultant.
2. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with airflow of at least 2000-fpm face velocity.
3. Leak Test: Test units for air tightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

M. Capacities and Characteristics:

1. Configuration: As indicated on plans.
2. Shape: As indicated on plans.
3. Attenuation Mechanism: As indicated on plans.
4. Maximum Pressure Drop: As indicated on plans.
5. Casing:
 - a. Attenuation: As indicated on plans.
 - b. Outer Material: Galvanized steel.
 - c. Inner Material: Galvanized steel.
6. Velocity Range: As scheduled on plans.
7. End Connection: 1-inch slip joint or Flange as required.
8. Length: As scheduled on plans.
9. Face Dimension:
 - a. Width: As scheduled on plans.
 - b. Height: As scheduled on plans.
10. Face Velocity: As scheduled on plans.
11. Dynamic Insertion Loss: As scheduled on plans.
12. Generated Noise: As scheduled on plans.

2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.

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5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Double wall.
- F. Vane Construction: Single wall for ducts up to 22 inches wide and double wall for larger dimensions.

2.9 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Pottorff; a division of PCI Industries, Inc.
 2. Ventfabrics, Inc.
 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Mounting: Mount operator in diffuser neck or as detailed on plans.

2.10 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Ductmate Industries, Inc.
 4. Flexmaster U.S.A., Inc.
 5. Greenheck Fan Corporation.
 6. McGill AirFlow LLC.
 7. Nailor Industries Inc.
 8. Pottorff; a division of PCI Industries, Inc.
 9. Ventfabrics, Inc.
 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
 4. Where space conditions do not allow hinged door provide sash locks on all sides. Door to be attached to duct with 4'-0" metal cable.
- C. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.

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4. Factory set at 10-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.11 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.

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- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd..
 2. Minimum Tensile Strength: 500 lbf/inch in the warp and 440 lbf/inch in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
1. Minimum Weight: 16 oz./sq. yd.
 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd.
 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

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7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.13 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft & control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 1. Install steel volume dampers in steel ducts.
 2. Install aluminum volume dampers in aluminum ducts.
 3. Install remote damper operations for all dampers located above gypsum board or other inaccessible type ceilings.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.

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- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream and downstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect flexible ducts to metal ducts with draw bands.
- O. Install duct test holes where required for testing and balancing purposes.

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- P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

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SECTION 233416

HVAC FANS

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.
- B. Seismic, vibration and wind criteria for this section are referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Airfoil centrifugal fans.
 - 2. Backward-inclined centrifugal fans.
 - 3. Forward-curved centrifugal fans.
 - 4. Plenum fans.
 - 5. Plug fans.
 - 6. In-line centrifugal fans.
 - 7. In line mixed flow fans.
 - 8. Roof up blast centrifugal exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan performance ratings on actual Project site elevations above sea level.
- B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

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1. Certified fan performance curves with system operating conditions indicated.
 2. Certified fan sound-power ratings.
 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 4. Material thickness and finishes, including color charts.
 5. Dampers, including housings, linkages, and operators.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals, including instructions on installation, operations, maintenance, pulley adjustment, receiving, handling, storage, safety information and cleaning. A troubleshooting guide, parts list, warranty and electrical wiring diagrams.
- 1.5 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
 - C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.
 - D. National Fire Protection Association (NFPA)
 1. 70 – National Electrical Code
 2. 90A-02 – Standard for the Installation of Air-Conditioning and Ventilating Systems

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3. 92A-06 – Recommend Practice for Smoke-Control System
4. 92B-05 – Standard for Smoke Management System in Malls, Atria, and Large Areas
5. 96-04 – Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

E. Underwriters Laboratories (UL) for Smoke Control

1. 507 – Electric Fans
2. 555 – Fire Dampers
3. 555S – Smoke Dampers
4. 705 – Standard Power Ventilators
5. 762 – Standard Power Roof Ventilators for Restaurant Exhaust Appliances
6. 793 – Snow Load

F. Each fan shall be given a balancing analysis which is applied to wheels at the outside radius. The maximum allowable static and dynamic imbalance is 0.05 ounces (Balance Grade of G6.3)

G. Comply with National Electrical Manufacturers Association (NEMA), standards for motors and electrical accessories.

H. Winds and Seismic Restraints to be provided in accordance with Section 230548. In addition, systems requiring wind restraints:

1. Shall be analyzed and stamped by a state license P.E. to the ASCE 7-02 Standard, which meets the IBC and local codes.
2. Shall be subject to be certified by a third party to the ASTM E330 Static Pressure Difference Standard.
3. Shall be analyzed using Computational Fluid Dynamics (CFD). The CFD simulates the flow of high speed (150 MPH) winds over the surface of objects. The Finite Element Analysis (FEA) is the results from the CFD and it can accurately predict the stress, strain, and deflection resulting from high wind loads.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

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1.7 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
- D. Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support.
- E. Roof type and ceiling exhaust fans: Show roof penetration requirements and reflected ceiling plans drawn to scale that coordinate roof penetrations and units mounted above ceiling. Show the following: roof framing and support members relative to duct penetrations; ceiling suspension assembly members; size and location of initial access modules for acoustical tile; ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers and access panels.
- F. Indicate and certify field measurements.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: Two sets for each type belt-driven unit.

PART 2 - PRODUCTS

2.1 BACKWARD/FORWARD-INCLINED CENTRIFUGAL UTILITY FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Greenheck
 - 2. Loren Cook Company.

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- B. Description: Factory-fabricated, -assembled, -tested, and -finished with baked enamel finish, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- C. Housings: Formed welded panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
 - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Horizontally split, bolted-flange housing.
 - 3. Spun inlet cone with flange.
 - 4. Outlet flange.
- D. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate and fastened to shaft with setscrews.
- E. Forward-Curve Wheels: Black-enameled or galvanized steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with setscrews.
- F. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- G. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 100,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 100,000 hours.
- H. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 100,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 100,000 hours.
 - 3. Extended Grease Lines: Extend grease lines from bearings to outside of inlet duct flange, terminate with grease fitting.

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- I. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 100,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 100,000 hours.
 - 3. Extended Grease Lines: Extend grease lines from bearings to outside of inlet duct flange, terminate with grease fitting.

- J. Belt Drives: Factory-mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor Size: 1.5.
 - 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 - 3. Motor Pulleys: Adjustable pitch for use with motors through 10 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - 5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 - 6. Motor Mount: Adjustable for belt tensioning.

- K. Accessories:
 - 1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 - 2. Cleanout Door: Bolted gasketed door allowing access to fan scroll, of same material as housing.
 - 3. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
 - 4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 - 5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
 - 6. Inlet Screens: Grid screen of same material as housing.
 - 7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
 - 8. Spark-Resistant Construction: AMCA 99.
 - 9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 - 10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
 - 11. Special Housing Coating: [Thermoplastic vinyl] [Epoxy] [Zinc] [Synthetic resin] [Phenolic] [Color-match enamel] [Polytetrafluoroethylene] [Vinyl ester] [Hot-dip galvanized] [Powder-baked enamel].

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12. Special Wheel Coating: Special Wheel Coating: [Thermoplastic vinyl] [Epoxy] [Zinc] [Synthetic resin] [Phenolic] [Color-match enamel] [Polytetrafluoroethylene] [Vinyl ester] [Hot-dip galvanized] [Powder-baked enamel].
13. Disconnect Switches: Factory Mounted and Shipped loose for field mounting, National Electrical Manufacturers Association (NEMA):
 - a. NEMA 1: indoor application no water.
 - b. NEMA 3R: outdoor application falling rain water.
 - c. NEMA 4: outdoor application hose directed water.
 - d. NEMA 4X: same as NEMA 4, but corrosion resistant.
 - e. NEMA 7 and 9: Explosion resistant indoor and outdoor use.
 - f. NEMA 12: Industrial use, dust-tight, and drip-tight, oil resistant for indoor use.
14. Dampers
 - a. Types: [Gravity] [Motorized].
 - b. Galvanized frames with pre-punched mounting holes.
 - c. Backdraft dampers are not suitable for downblast or bottom angular downblast discharge positions.
 - d. Balanced for minimal resistance to flow.
15. Drain Connection
 - a. Threaded connection.
 - b. Provided to drain moisture form the bottom of the fan housing; fan supplied without drain plug, unless specified.
16. Special Finish
 - a. Epoxy – Indoor, one part polyamide activated epoxy resin coating with moisture and moderate chemical resistance.
 - b. Industrial Epoxy – thermosetting epoxy powder with chemical resistance to a wide variety of chemicals.
 - c. Epoxy Phenolic – Cross-linked epoxy phenolic resin. Chemical resistance to a wide range of acids, alkalis and solvents.
 - d. Baked Phenolic-Pure thermoset phenolic, withstands concentrated acids and alkalis at higher temperatures than epoxy or epoxy phenolic.
 - e. Fluorocarbon-Low bake Teflon with good release properties and satisfactory for mild resistance. Anti-Stick surface.
 - f. Plastiscol (PVC) – Abrasive resistant, resists most acids and alkalis to 160 Fahrenheit, soft rubber like texture with no seams or joints.
 - g. Vinylidene Fluoride – high performance fluoropolymer with excellent resistance to most acids and solvents.

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- h. Coal Tar Epoxy – a coal pitch product, good resistance to moisture, suitable for marine and petroleum installations.
 - i. Zinc Rich Paint – coating with a high percentage of zinc (80-90%) thus providing cathodic protection by the same mechanism as galvanizing. Consult manufacturer for additional information.
- 17. Grease Trap
 - a. Constructed of aluminum.
 - b. Includes drain connection.
 - c. Collects grease residue.
 - d. Optional with grease absorbent sock.
- 18. Heat Slinger and Shaft Seal
 - a. Heat slinger is an aluminum cooling disc.
 - b. Disc dissipates heat along the fan shaft.
 - c. Shaft seal is aluminum rub ring.
- 19. Inlet and Outlet Guards
 - a. Constructed of expanded metal mounted in a steel fram to provide protection for non-ducted installations.
- 20. Inlet Vane Dampers
 - a. Zinc plated steel blade axles, stainless steel washer and bearings.
 - b. Suitable for temperatures up to 200°F.
 - c. External Inlet Vane Dampers not available in unit size 210 and smaller.
- 21. Temperature Ratings
 - a. Fan should be capable of operating at [normal temperature of 200 Fahrenheit] or [high temperatures of 500 Fahrenheit for 4 hours or 1000 Fahrenheit for 15 minutes].
 - b. Heat slinger required on operating temperature of 500 Fahrenheit and above.
 - c. All steel construction required on operating temperature above 500°F.
 - d. Unit to include UL for high temperature option for smoke control system when required.
 - e. Type of Ratings: [Standard operating temperature] [Standard with heat slinger] High Temperature Option] [High Temperature Option with UL listing].
- 22. Weatherhood

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- a. Completely cover motor and drive compartments.
 - b. Vented to provide sufficient motor cooling.
 - c. Required to meet UL 705 and 762 ratings.
23. Special Housing Coating: [Thermoplastic vinyl] [Epoxy] [Zinc] [Synthetic resin] [Phenolic] [Color-match enamel] [Polytetrafluoroethylene] [Vinyl ester] [Hot-dip galvanized] [Powder-baked enamel]; <Insert manufacturer's name and trade name>.
24. Special Wheel Coating: [Thermoplastic vinyl] [Epoxy] [Zinc] [Synthetic resin] [Phenolic] [Color-match enamel] [Polytetrafluoroethylene] [Vinyl ester] [Hot-dip galvanized] [Powder-baked enamel]; <Insert manufacturer's name and trade name>.
- L. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Enclosure Type: Totally-enclosed, fan-cooled.
- M. Capacities and Characteristics: As scheduled on plans.
- N. Maximum Sound Power Levels:
1. Discharge Sound Power:
 - a. 1st Octave: <Insert dB.>
 - b. 2nd Octave: <Insert dB.>
 - c. 3rd Octave: <Insert dB.>
 - d. 4th Octave: <Insert dB.>
 - e. 5th Octave: <Insert dB.>
 - f. 6th Octave: <Insert dB.>
 - g. 7th Octave: <Insert dB.>
 - h. 8th Octave: <Insert dB.>
 2. Inlet Sound Power:
 - a. 1st Octave: <Insert dB.>
 - b. 2nd Octave: <Insert dB.>
 - c. 3rd Octave: <Insert dB.>
 - d. 4th Octave: <Insert dB.>
 - e. 5th Octave: <Insert dB.>
 - f. 6th Octave: <Insert dB.>
 - g. 7th Octave: <Insert dB.>
 - h. 8th Octave: <Insert dB.>
- O. Restraint and Isolation: Spring type to comply with Section 230548, "Vibration, Wind, Seismic and Noise Controls."

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P. Spark Arrestance Class: [A] [B] [C].

2.2 CENTRIFUGAL ROOF EXHAUST FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenheck
2. Loren Cook Company.

B. Housing: Removable, hinged heavy gauge-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades, statically and dynamically balanced in accordance with AMCA Standard 204-5.

D. Belt Drives

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

E. Shafts and Bearings

1. Fan shaft shall be ground and polished solid steel with an anti corrosive coating.
2. Permanently sealed bearings or pillow block ball bearings.
3. Bearing shall be selected for a minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
4. Bearings are 100 percent factory tested.
5. Fan Shaft first critical speed is at least 25 percent over maximum operating speed.

F. Accessories

1. UL Listed.
2. Disconnect Switch: NEMA 4x Non-fusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.

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3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
 4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
 5. Welded construction for units requiring UL 762 option.
 6. Bird screen on aluminum construction.
 7. Spark-Resistant Construction: AMCA 99.
 8. Special Housing Coating: [41 - Pro Polyester] [Baked enamel].
 9. Dampers:
 - a. Types: [Gravity] [Motorized].
 - b. Galvanized frames with pre-punched mounting holes.
 - c. Balanced for minimal resistance to flow.
 10. Grease Collector
 - a. Constructed of aluminum.
 - b. Includes drain connection.
 - c. Collects grease residue.
- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Built-in cant and mounting flange
 2. Overall Height: Minimum 12 inches (300 mm).
 3. Sound Curb: Curb with sound-absorbing insulation.
 4. Pitch Mounting: Manufacture curb for roof slope.
 5. Metal Liner: Galvanized steel.
 6. Mounting Pedestal: Galvanized steel with removable access panel.
 7. Vented Curb: Unlined with louvered vents in vertical sides for all kitchen fans.
 8. Extended base with access rear at all fans with dampers (F.S.D., A.L.D. or Gravity).
- H. Seismic, vibration and wind criteria for this section are referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- I. Capacities and Characteristics: As scheduled on plans.
- J. Maximum Sound Power Levels
- 2.3 FORWARD-CURVED CENTRIFUGAL FANS
- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Greenheck
 - 2. Loren Cook Company.
- D. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- E. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
 - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Horizontally split, bolted-flange housing.
 - 3. Spun inlet cone with flange.
 - 4. Outlet flange.
- F. Forward-Curved Wheels: Black-enameled or galvanized steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.
- G. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
 - 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- H. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- I. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.

1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- J. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- K. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor Size: 1.5.
 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 6. Motor Mount: Adjustable for belt tensioning.
- L. Accessories:
1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 2. Cleanout Door: Bolted gasketed door allowing access to fan scroll, of same material as housing.
 3. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
 4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 5. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
 6. Inlet Screens: Grid screen of same material as housing.
 7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
 8. Spark-Resistant Construction: AMCA 99.
 9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

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- M. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Enclosure Type: Totally-enclosed, fan-cooled.
- N. Capacities and Characteristics: As scheduled on plans.

2.4 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
 - 1. Greenheck
 - 2. Loren Cook Company.
- D. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor [and disconnect switch], drive assembly, and support structure.
- E. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
 - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Horizontally split, bolted-flange housing.
 - 3. Spun inlet cone with flange.
 - 4. Outlet flange.
- F. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades [welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate] and fastened to shaft with setscrews.

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- G. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- H. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
1. Ball-Bearing Rating Life: ABMA 9, L10 at [50,000 hours] [120,000 hours] <Insert hours>.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at [50,000 hours] [120,000 hours] <Insert hours>.
- I. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at [50,000 hours] [120,000 hours] <Insert hours>.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at [50,000 hours] [120,000 hours] <Insert hours>.
- J. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at [50,000 hours] [120,000 hours] <Insert hours>.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at [50,000 hours] [120,000 hours] <Insert hours>.
- K. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor Size: [1.5] [1.4] [1.3] [1.2].
 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 3. Motor Pulleys: Adjustable pitch for use with motors through [5] <Insert number> hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan

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or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

6. Motor Mount: Adjustable for belt tensioning.

L. Accessories:

1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
2. Cleanout Door: [Bolted] [Quick-opening, latch-type] gasketed door allowing access to fan scroll, of same material as housing.
3. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
5. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
6. Discharge Dampers: Assembly with [parallel] [opposed] blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
7. Inlet Screens: Grid screen of same material as housing.
8. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
9. Spark-Resistant Construction: AMCA 99.
10. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
11. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

M. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally-enclosed, fan-cooled.

N. Capacities And Characteristics:

1. Housing Material: [Reinforced steel] [Shaped fiberglass-reinforced plastic] [Aluminum] [Stainless steel].
2. Special Housing Coating: [Thermoplastic vinyl] [Epoxy] [Zinc] [Synthetic resin] [Phenolic] [Color-match enamel] [Polytetrafluoroethylene] [Vinyl ester] [Hot-dip galvanized] [Powder-baked enamel]; <Insert manufacturer's name and trade name>.
3. Wheel Size (Diameter): <Insert inches (mm).>
4. Wheel Material: [Steel] [Aluminum] [One-piece fiberglass-reinforced plastic] [Stainless steel].
5. Special Wheel Coating: [Thermoplastic vinyl] [Epoxy] [Zinc] [Synthetic resin] [Phenolic] [Color-match enamel] [Polytetrafluoroethylene] [Vinyl ester] [Hot-dip galvanized] [Powder-baked enamel]; <Insert manufacturer's name and trade name>.

6. Airflow: <Insert cfm (L/s).>
7. Static Pressure: <Insert inches wg (Pa).>
8. Class: [I] [II] [III].
9. Brake Horsepower: <Insert value.>
10. Drive Type: [Belt] [Direct].
11. Fan Rpm: <Insert value.>
12. Outlet Velocity: <Insert fpm (m/s).>
13. Motor Size: <Insert value> hp.
14. Motor Rpm: <Insert value.>
15. Electrical Characteristics:
 - a. Volts: <Insert value.>
 - b. Phase: <Insert value.>
 - c. Hertz: <Insert value.>
 - d. Minimum Circuit Ampacity: <Insert value.>
 - e. Maximum Overcurrent Protection: <Insert value.>
16. Discharge Sound Power:
 - a. 1st Octave: <Insert dB.>
 - b. 2nd Octave: <Insert dB.>
 - c. 3rd Octave: <Insert dB.>
 - d. 4th Octave: <Insert dB.>
 - e. 5th Octave: <Insert dB.>
 - f. 6th Octave: <Insert dB.>
 - g. 7th Octave: <Insert dB.>
 - h. 8th Octave: <Insert dB.>
17. Inlet Sound Power:
 - a. 1st Octave: <Insert dB.>
 - b. 2nd Octave: <Insert dB.>
 - c. 3rd Octave: <Insert dB.>
 - d. 4th Octave: <Insert dB.>
 - e. 5th Octave: <Insert dB.>
 - f. 6th Octave: <Insert dB.>
 - g. 7th Octave: <Insert dB.>
 - h. 8th Octave: <Insert dB.>
18. Vibration Isolators: [Spring isolators] [Restrained spring isolators] <Insert type> having a static deflection of [1 inch (25 mm)] <Insert deflection>.
19. Spark Arrestance Class: [A] [B] [C].

2.5 IN-LINE CENTRIFUGAL FANS [BASED ON GREENHECK BSQ]

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Greenheck
 - 2. Loren Cook Company.
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet duct flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub. Non-overloading backward inclined centrifugal wheel.
- F. Motors
 - 1. Motor enclosures: Totally enclosed fan cooled.
 - 2. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
- G. Shafts and Bearings
 - 1. Fan shaft shall be ground and polished solid steel with an anti corrosive coating.
 - 2. Permanently sealed bearings or pillow block ball bearings.
 - 3. Bearing shall be selected for a minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
 - 4. Fan shaft first critical speed is at least 25 percent over maximum operating speed.
- H. Housing / Cabinet Construction
 - 1. Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
 - 2. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.
- I. Housing Supports and Drive Frame

1. Housing supports are constructed of structural steel with formed flanges.
 2. Drive frame is welded steel which supports the shaft and bearing and reinforcement for the housing.
 3. Pivoting motor plate with adjusting screws to make belt tensioning operations.
- J. Disconnect Switches
1. NEMA Rated: NEMA 1 for indoor application, NEMA 4x for exterior or any areas subject to moisture.
 2. Positive electrical shut-off.
 3. Wired from fan motor to junction box installed within motor compartment.
- K. Drive Assembly: (Belt Drive)
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
 2. Belts: Static free and oil resistant.
 3. Pulleys: Cast type, keyed, and securely attached to wheel and motor shafts.
 4. Motor pulleys are adjustable for final system balancing.
 5. Readily accessible for maintenance.
- L. Duct Collars
1. Square design to provide a large discharge area.
 2. Inlet and discharge collars provide easy duct connection.
- M. Access Panel
1. Two sided access panels, permit easy access to all internal components.
 2. Located perpendicular to the motor mounting panel.
- N. Accessories
1. Extended Lube Lines: Grease zerks on housing exterior allows for lubrication of bearings without disassembling the fan.
 2. Insulated Housing: Thickness: [1] inch thick fiber glass liner for noise reduction and condensation control
 3. Spark-Resistant Construction: AMCA 99.
 4. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 5. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
 6. Special Housing Coating: Powder-baked enamel
 7. Disconnect Switches: Factory Mounted and Shipped loose for field mounting, National Electrical Manufacturers Association (NEMA):
 - a. NEMA 1: indoor application.
 - b. NEMA 4X: outdoor application.

- c. NEMA 7 and 9: Explosion resistant indoor and outdoor use.
 - d. NEMA 12: Industrial use, dust-tight, and drip-tight, oil resistant for indoor use.
8. Dampers:
- a. Types: [Gravity] [Motorized].
 - b. Galvanized frames with pre-punched mounting holes
 - c. Backdraft dampers are not suitable for downblast or bottom angular downblast discharge positions.
 - d. Balanced for minimal resistance to flow.
9. Inlet and Outlet Guards
- a. Constructed of expanded metal mounted in a steel frame to provide protection for non-ducted installations.
10. Restraint and Isolation: Spring type to comply with Section 230548, "Vibration, Wind, Seismic and Noise Controls."
11. Belt Guards: Three-sided fabricated steel belt guard covers drive and motor.
12. Weatherhood
- a. Completely cover motor and drive compartments.
 - b. Vented to provide sufficient motor cooling.
 - c. Required to meet UL 705 and 762 ratings.
13. Motor Cover: Constructed of galvanized steel, covers motor and drives for safety, standard on unit specified with UL.
14. Pressure Probe: 1/4-inch diameter tube in fan venture that allows hook up to manometer
- O. Capacities and Characteristics: As scheduled on plans.
- 2.6 IN-LINE TUBULAR CENTRIFUGAL FANS [BASED ON GREENHECK TCB SERIES]
- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- 1. Greenheck
 - 2. Loren Cook Company.
- B. General
- 1. Base fan performance at standard conditions (density 0.075 lb/ft³).

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2. Fans selected shall be capable of accommodating static pressure and flow variations of +/- 15% of scheduled values.
3. Each fan shall be belt driven in AMCA arrangement 9 only with wheel secured to the fan shaft.
4. Fans are to be equipped with lifting lugs.
5. After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permator (Polyester Urethane), electrostatically applied and baked. Finish color shall be industrial gray. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.

C. Fan Housing and Outlet

1. Fan housing to be aerodynamically designed with punched inlet and outlet flanges for ductwork connection on inline fans.
2. Fan housing shall be constructed of rolled steel with a continuous seam weld.
3. Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings.
4. Either an OSHA compliant weatherhood, or an OSHA compliant belt guard shall be included to completely cover the motor pulley and belt(s).

D. Fan Wheel

1. The fan wheel shall be of the non-overloading backward inclined centrifugal type. Wheels shall be statically and dynamically balanced to Balance Grade G6.3 per ANSI S2.19 Fan Wheel Level of Construction as follows:

Level I: (Under 2" S.P.)

Wheel shall be constructed with half-welded and half-riveted aluminum. The maximum pressure capabilities shall be 2 inches W.G.

Level II: (2" to 4.5" S.P.)

Wheel shall be constructed with completely welded aluminum. The maximum pressure capabilities shall be 4.5 inches W.G.

2. Aluminum parts shall not require protective coating.
3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

E. Fan Motors and Drive

1. Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, as scheduled on plans, Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor.

2. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.
3. Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.
4. Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or roller pillow block type.
5. Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.
6. Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class {Average Life or (L-50) of 400,000 hours}.
7. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed.
8. Bearings shall have extended lube lines with Zerk fittings to allow for lubrication.

F. Roof Mounted Supply Fans

1. Curb cap shall be constructed of painted steel and welded to the fan housing.
2. Hoods shall be inter-locking panel style for superior strength. Hood construction shall be painted steel.
3. One-half inch galvanized mesh bird screen shall be horizontally mounted in the intake perimeter of the hood.

G. Roof Mounted Upblast Fans

1. Curb cap shall be constructed of painted steel and welded to the fan housing.
2. Windbands shall be constructed of heavy gauge painted steel with reinforced edges and bolted seams.
3. Butterfly dampers are to be supplied on all fans size 18 and greater. For fans smaller than size 18, stack cap dampers shall be provided. All dampers shall be constructed of aluminum.

H. Accessories

1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
2. Cleanout Door: Bolted gasketed door allowing access to fan scroll, of same material as housing.
3. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
4. Companion Flanges: Rolled flanges for duct connections of same material as housing.

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5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Inlet Screens: Grid screen of same material as housing.
7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
8. Spark-Resistant Construction: AMCA 99.
9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
11. Disconnect Switches: Factory Mounted and Shipped loose for field mounting, National Electrical Manufacturers Association (NEMA):
 - a. NEMA 1: indoor application no water.
 - b. NEMA 4X: outdoor units.
 - c. NEMA 7 and 9: Explosion resistant indoor and outdoor use.
 - d. NEMA 12: Industrial use, dust-tight, and drip-tight, oil resistant for indoor use.
12. Heat Slinger and Shaft Seal
 - a. Heat slinger is an aluminum cooling disc.
 - b. Disc dissipates heat along the fan shaft.
 - c. Shaft seal is aluminum rub ring.
13. Inlet and Outlet Guards
 - a. Constructed of expanded metal mounted in a steel frame to provide protection for non-ducted installations.
14. Inlet Vane Dampers
 - a. Zinc plated steel blade axles, stainless steel washer and bearings.
 - b. Suitable for temperatures up to 200 Fahrenheit.
 - c. External Inlet Vane Dampers not available in unit size 210 and smaller.
15. Restraint and Isolation: Spring type to comply with Section 230548, "Vibration, Wind, Seismic and Noise Controls."
16. Temperature Ratings
 - a. Fan should be capable of operating at [normal temperature of 200°F] or [high temperatures of 500°F for 4 hours or 1000°F for 15 minutes].
 - b. Heat slinger required on operating temperature of 500°F and above.
 - c. All steel construction required on operating temperature above 500°F.
 - d. Unit to include UL for high temperature option for smoke control system when required.

- e. Type of Ratings: [Standard operating temperature] [Standard with heat slinger] [High Temperature Option] [High Temperature Option with UL listing]

17. Weatherhood

- a. Completely cover motor and drive compartments.
- b. Vented to provide sufficient motor cooling.

I. Capacities and Characteristics: As scheduled on plans.

J. Vibration Isolators: Seismic, vibration and wind criteria for this section are referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.

K. Maximum Sound Power Levels

2.7 IN-LINE AXIAL FANS [GREENHECK AX]

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- 1. Greenheck
- 2. Loren Cook Company.

B. Fan Housing and Outlet

- 1. Fan housing to be aerodynamically designed with integral punched flanges for sizes up through size 160 (63 inch diameter).
- 2. Fan housing shall be constructed of rolled steel with a continuous seam weld.
- 3. Housing to be coated with a minimum of 3 mils of Permator, an electrostatically applied and baked polyester urethane. Finish color shall be gray. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.
- 4. Motor support framework to be constructed of structural steel that is suitable to handle the weights of the motor and propeller. Motor supports within the fan housing to be welded to the fan casing. Bolted construction is not acceptable. All support framework to be coated with a minimum of 3 mils of Permator, an electrostatically applied and baked polyester urethane. Finish color shall be gray. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.

C. Fan Impeller

- 1. A taper lock bushing shall be used to mount the propeller to the motor shaft.

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2. Fan propeller shall use cast aluminum airfoil blades. Blades to be adjustable within a cast aluminum hub to allow for performance changes. The propeller shall be both statically and dynamically balanced.
3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

D. Fan Motors and Drive

1. Motors shall be TEAO with a 1.15 service factor.
2. Motors must be standard NEMA T-Frame designs that are readily available from motor vendors. Suppliers using C-Face or Pad Mount motors must include provisions to provide replacement motors in case of a motor failure due to long motor lead times.
3. Motors for emergency smoke ventilation shall use insulation class F or H as noted below:
 - a. 302°F (150°C) for a minimum of 5 hours of operation requires Class F insulation.
 - b. 482°F (250°C) for a minimum of 2 hours of operation requires Class F insulation.
 - c. 500°F (260°C) for a minimum of 4 hours of operation requires Class H insulation.
 - d. 572°F (300°C) for a minimum of 1 hour of operation requires Class H insulation.

E. Accessories

1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
2. Cleanout Door: Bolted gasketed door allowing access to fan scroll, of same material as housing.
3. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Inlet Screens: Grid screen of same material as housing.
7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
8. Spark-Resistant Construction: AMCA 99.
9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
11. Disconnect Switches: Factory Mounted and Shipped loose for field mounting, National Electrical Manufacturers Association (NEMA):
 - a. NEMA 1: indoor application no water.
 - b. NEMA 3R: outdoor application falling rain water.
 - c. NEMA 4: outdoor application hose directed water.

- d. NEMA 4X: same as NEMA 4, but corrosion resistant.
 - e. NEMA 7 and 9: Explosion resistant indoor and outdoor use.
 - f. NEMA 12: Industrial use, dust-tight, and drip-tight, oil resistant for indoor use.
12. Dampers
- a. Types: Motorized.
 - b. Galvanized frames with pre-punched mounting holes
 - c. Backdraft dampers are not suitable for downblast or bottom angular downblast discharge positions.
 - d. Balanced for minimal resistance to flow
13. Drain Connection
- a. Threaded connection.
 - b. Provided to drain moisture form the bottom of the fan housing; fan supplied without drain plug, unless specified.
14. Grease Trap
- a. Constructed of aluminum.
 - b. Includes drain connection.
 - c. Collects grease residue.
 - d. Optional with grease absorbent sock.
15. Heat Slinger and Shaft Seal
- a. Heat slinger is an aluminum cooling disc.
 - b. Disc dissipates heat along the fan shaft.
 - c. Shaft seal is aluminum rub ring.
16. Inlet and Outlet Guards
- a. Constructed of expanded metal mounted in a steel frame to provide protection for non-ducted installations.
17. Temperature Ratings
- a. Fan should be capable of operating at [normal temperature of 200 Fahrenheit] or [high temperatures of 500°F for 4 hours or 1000°F for 15 minutes].
 - b. Heat slinger required on operating temperature of 500°F and above.
 - c. All steel construction required on operating temperature above 500°F.
 - d. Unit to include UL for high temperature option for smoke control system when required.

- e. Type of Ratings: [Standard operating temperature] [Standard with heat slinger] High Temperature Option] [High Temperature Option with UL listing].

18. Weatherhood

- a. Completely cover motor and drive compartments.
- b. Vented to provide sufficient motor cooling.
- c. Required to meet UL 705 and 762 ratings.

F. Capacities and Characteristics: As scheduled on plans.

G. Vibration Isolators: Seismic, vibration and wind criteria for this section are referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.

2.8 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Rating: Establish flow rate, pressure, power air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans level and plumb.

B. Support floor-mounting units using isolators as specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

- 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

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- D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Support suspended units from structure using threaded steel rods and isolators as specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install units with clearances for service and maintenance.
- G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times the specified static pressure, to nearest floor drain.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.

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4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Upon completion of installation of centrifugal fans, and after motor has been energized with normal power source, test equipment to demonstrate compliance. Where possible field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected. Perform necessary Interdisciplinary Tests and Functional Performance Tests according to the manufacturer's procedures.

D. Interdisciplinary Pre-Startup and Startup Tests

1. Conduct interdisciplinary pre-start up and start up tests as per the manufacturer's start up procedures. Contractor shall submit signed start up affidavit signed by the factory authorized service representative indicating that all of the manufacturer's pre-startup and start up procedures have been successfully completed.

E. Functional Performance Tests

1. Submit signed functional performance testing affidavit signed by the factory authorized service representative indicating that all of the manufacturer's functional performance tests have been successfully completed.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 233600

AIR TERMINAL UNITS

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. Bypass, single-duct air terminal units.
 - 2. Dual-duct VAV air terminal units.
 - 3. Fan-powered air terminal units.
 - 4. Shutoff, single-duct air terminal units.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
 - 4. Seismic-restraint devices.
- B. LEED Submittal:
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment".
- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

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1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
 3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Instructions for resetting minimum and maximum air volumes.
 2. Instructions for adjusting software set points.
- 1.5 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up".

PART 2 - PRODUCTS

2.1 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Anemostat Products; a Mestek Company.
 2. Nailor Industries, Inc.
 3. Titus.
- B. Configuration: Volume-damper assembly inside unit casing with control components mounted inside a control box with hinged access door.
- C. Casing: single wall.
1. Casing Lining: Adhesive attached, 1/2-inch- (13-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.

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4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 Rated, 1 percent of nominal airflow at 3-inch wg (750-Pa) inlet static pressure.
 2. Damper position shall be indicated on the end of the shaft on the outside of the casing.
 3. 24 volt actuator.
- E. Airflow Sensor
1. A multi-point airflow sensor (Velocity Wing) of the center averaging type shall be located in the terminal inlet. The airflow sensor shall be aerodynamically designed to provide low pressure loss, quiet operation and have not less than 20 sensing points on any given size unit. The sensor shall amplify the velocity pressure signal and provide feed back of actual flow to the controller.
 2. An identification label with piping/wiring diagram and airflow calibration chart shall be affixed to each unit. Flow taps with caps, separate from the airflow sensor or controller taps shall be provided for flow readjustment.
- F. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1-inch (2.5-mm), and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.
- G. Direct Digital Controls: Factory mount damper actuators and microprocessor-based controller in control compartment. Control devices shall be provided by the BMS as specified Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
1. Damper Actuator: 24-V.
 2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer connected to multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes.

2.2 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electro-galvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Steel Cables: Galvanized Steel complying with ASTM A 603 Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

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- D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, [coil type,] and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems".
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.
- D. Install central 24-Volt transformer and 24-Volt power circuit to all actuators.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", Chapter 4, "Hangers and Supports".
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches (100-mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches (100-mm) thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.

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- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on air terminal units that are suspended with vibration isolators.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- F. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.4 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping", connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to "Division 23 Section "Ductwork".
- D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories".

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3.5 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Inspect components, assemblies, and equipment installations, including connections, and to assist in testing and provide written report on any deviations or defective components.
- D. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Air terminal unit will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION

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SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

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, and the following apply to this Section 8.
- B. Vibration and wind criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.
- C. Noise criteria for this section is referenced in specification section 230548.1. Vendor/manufacturer/contractor is responsible for this section 230548.1 in its entirety.

1.2 SUMMARY

- A. Section includes:
 - 1. Round ceiling diffusers.
 - 2. Rectangular and square ceiling diffusers.
 - 3. Perforated diffusers.
 - 4. Louver face diffusers.
 - 5. Linear bar diffusers.
 - 6. Linear slot diffusers.
 - 7. Ceiling-integral continuous diffusers.
 - 8. Adjustable bar registers and grilles.
 - 9. Linear bar grilles.
- B. Related sections:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

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1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- E. Source quality-control reports.

1.4 ACOUSTICAL SPECIFICATION FOR DIFFUSERS

- A. Air Distribution System; Diffusers, Grilles and Register Noise: Maximum permissible sound power level in octave bands of airborne transmission through the combination of grille, registers, diffusers, or related pressure reducing devices, when operated at the maximum inlet pressure and cfm in installed condition per plans and specifications shall be as specified under noise, and vibration control portion of these specifications.

1.5 PERFORMANCE TESTING

- A. To be determined.

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PART 2 - PRODUCTS

2.1 GENERAL

A. Diffusers, Registers, Grilles

1. Basis-of-Design Product: Subject to compliance with requirements, provide as scheduled on plans or comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Nailor Industries Inc.
 - c. Titus.
2. Devices attached to variable air volume systems shall be specifically designed for variable-air-volume flows.
3. Finish: Baked enamel, color selected by Architect Anodized aluminum or as scheduled.
4. Mounting: As required to suit specific application.
5. Pattern: Fully adjustable.
6. Dampers: Radial opposed blade.
7. Accessories: As scheduled.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.

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- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Provide remote opposed blade dampers with cable operations at all linear diffusers with cable operator located in diffuser accessible turnover diffuser face.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 234100

PARTICULATE AIR FILTRATION

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.
- B. Vibration, wind, noise & flood criteria for this vendor are referenced in specification section 230548 and 230548-A. Vendor/manufacturer/contractor is responsible for this section in its entirety.
- C. VOC Limits for Adhesives, Sealants, Paints and Coatings Section 018101
- D. Construction and Demolition Waste Management Section 018102
- E. Construction Indoor Air Quality (IAQ) Management Section 018103

1.2 SUMMARY

- A. Section includes:
 - 1. Metal panel filters.
 - 2. Flat panel filters (construction filters).
 - 3. Pleated panel pre filters.
 - 4. Non-supported bag filters.
 - 5. Rigid cell box filters.
 - 6. V-bank cell filters.
 - 7. Self-supported pocket filters.
 - 8. Automatic roll filters.
 - 9. Bulk media.
 - 10. Front- and rear-access filter frames.
 - 11. Side-service housings.
 - 12. Filter gages.
- B. General

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1. Air handling units with Factory filter casings may have the air filtering racks and media installed at the air handling unit manufacturer's factory or field installed at the Project Site at the Mechanical Subcontractor's option.
2. If fan powered terminals are operated during construction, the Mechanical Subcontractor shall install and maintain temporary 1" throw away filters on the induction air opening to these devices.
3. Factory-built air handling units specified with electronic air cleaners shall have the electronic air cleaners factory installed complete with all wiring, piping and drains, and the electronic air cleaner control panel factory installed on or near the air handling unit. Provide a single point connection for the Division 16 power wiring. All interlock wiring shall be factory installed at the air handling unit manufacturer's factory or by the Mechanical Subcontractor at the project site.
4. If air-handling units are operated during construction, the Mechanical Subcontractor shall install and maintain MERV 8 filters.
5. All systems shall be equipped with minimum MERV 8 filters on return air ducts during construction; replace all AHU filters with MERV13 prior to occupancy.
6. If the electronic air cleaners are operated during construction, the Mechanical Subcontractor shall furnish all chemicals, maintenance, etc., and perform adequate washing cycles.
7. All systems, equipment and materials shall be approved for use in the City of Weehawken.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.
 1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
 2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 3. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

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1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
 - 2. Comply with ASHRAE 52.1 for arresance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
- C. Comply with NFPA 90A and NFPA 90B.
- D. National Air Filtration Association (NAFA).
- E. ARI Standard 850.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 FLAT PANEL FILTERS OR CONSTRUCTION FILTER (FPF)

- A. Description: Factory-fabricated, self-supported, flat, non-pleated, panel-type, disposable air filters with holding frames.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders Precisionaire Tyde 325 or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.

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- d. Viledon.
- B. Filter Unit Class: UL 900, Class 2.
- C. Media: Cotton and synthetic fibers coated with nonflammable adhesive.
 - 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Metal Retainer: Upstream side and downstream side.
- D. Filter-Media Frame: 10 gauge internal steel rod grid sealed or bonded to the media.
- E. Capacities and Characteristics:
 - 1. Face Area: As scheduled on plans.
 - 2. Face Dimensions: As scheduled on plans.
 - 3. Depth: As scheduled on plans.
 - 4. System Airflow: As scheduled on plans.
 - 5. Maximum or Rated Face Velocity: 500 fpm.
 - 6. Arrestance: 85 percent when tested according to ASHRAE 52.1.
 - 7. MERV Rating: 8 when tested according to ASHRAE 52.2.
 - 8. Initial Resistance

2.2 PLEATED PANEL PRE FILTERS (PPF)

- A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders Precisionaire Pre Pleat 40 or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Viledon.
- B. Filter Unit Class: UL 900, Class 2.
- C. Media: Cotton and synthetic fibers.
 - 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Separators shall be bonded to the media to maintain pleat configuration.

3. Welded wire grid shall be on downstream side to maintain pleat.
4. Media shall be bonded to frame to prevent air bypass.
5. Support members on upstream and downstream sides to maintain pleat spacing.

D. Filter-Media Frame: High wet strength beverage board frame sealed or bonded to the media.

E. Capacities and Characteristics:

1. Face Area: As scheduled on plans.
2. Face Dimensions: As scheduled on plans.
3. Thickness or Depth: As scheduled on plans.
4. Surface Area: As scheduled on plans.
5. Number of Filters: As scheduled on plans.
6. System Airflow: As scheduled on plans.
7. Maximum or Rated Face Velocity: 500.
8. Efficiency: 90 percent on particles 20 micrometers and larger at 500 fpm.
9. Arrestance: 95 percent when tested according to ASHRAE 52.1.
10. Recommended Final Resistance: As scheduled on plans.
11. MERV Rating: 8 when tested according to ASHRAE 52.2.

2.3 NON-SUPPORTED BAG FILTERS (UBF)

A. Description: Factory-fabricated, dry, extended-surface, non-supported filters with header frames. For use on constant volume systems.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders-Precisionaire Model Precision Pak or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Viledon.

B. Filter Unit Class: UL 900, Class 1.

C. Media: Synthetic material constructed so individual pockets are maintained in tapered form under rated-airflow conditions by flexible internal supports.

D. Filter-Media Frame: Galvanized steel.

E. Capacities and Characteristics:

1. Minimum number of pockets: 1 per 3 inches of width.

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2. Face Area: As scheduled on plans.
3. Face Dimensions: As scheduled on plans.
4. Thickness or Depth: As scheduled on plans.
5. Surface Area: As scheduled on plans.
6. Number of Filters: As scheduled on plans.
7. System Airflow: As scheduled on plans.
8. Maximum or Rated Face Velocity: 500.
9. Efficiency: 90 percent on particles 20 micrometers and larger at 500 fpm.
10. Initial Resistance: .36.
11. Recommended Final Resistance: As scheduled on plans.
12. MERV Rating 13 when tested according to ASHRAE 52.2.

2.4 RIGID CELL BOX FILTERS (BF)

- A. Description: Factory-fabricated, disposable, packaged air filters with media perpendicular to airflow, and with holding frames.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders Precisionaire model rigid-air or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. National Air Filter.
- B. Filter Unit Class: UL 900, Class 1.
- C. Media: Fibrous material constructed so individual pleats are maintained in tapered form under rated-airflow conditions by flexible internal supports.
 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Filter-Media Frames: Galvanized steel header or box style as required.
- E. Capacities and Characteristics:
 1. Face Area: As scheduled on plans.
 2. Face Dimensions: As scheduled on plans.
 3. Thickness or Depth: As scheduled on plans.
 4. Surface Area: As scheduled on plans.
 5. System Airflow: As scheduled on plans.
 6. Maximum or Rated Face Velocity: 500.

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7. Initial Resistance: MERV 11: .36", MERV 13: .52", MERV14: .65".
8. MERV Rating: 13 when tested according to ASHRAE 52.2.

2.5 V-BANK CELL FILTERS (VBF)

- A. Description: Factory-fabricated, disposable, packaged air filters with media angled to airflow, and with holding frames.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders Precisionaire Model Super Flow V or Viledon MVFR 95 or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Viledon.
- B. Filter Unit Class: UL 900, Class 1 Viledon only.
- C. Media: Fibrous material constructed so individual pleats are maintained in tapered form under rated-airflow conditions by flexible internal supports.
 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Media shall be coated with an antimicrobial agent.
- D. Filter-Media Frames: Plastic.
- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- F. Capacities and Characteristics:
 1. Face Area: As scheduled on plans.
 2. Face Dimensions: As scheduled on plans.
 3. Thickness or Depth: As scheduled on plans.
 4. Surface Area: As scheduled on plans.
 5. System Airflow: As scheduled on plans.
 6. Maximum or Rated Face Velocity: 500 fpm.
 7. Initial Resistance: MERV 13: .27"; MERV 14, 15: .36".
 8. Recommended Final Resistance: .27 at 500 fpm MERV 13.
 9. MERV Rating: 13, 14, 15 when tested according to ASHRAE 52.2.

2.6 SELF-SUPPORTED POCKET FILTERS (PF)

- A. Description: Factory-fabricated, panel-type, disposable air filters with contoured media for extended surface.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders Precisionaire Precision Pak XDH or comparable product by one of the following:
 - a. Viledon.
- B. Filter Unit Class: UL 900, Class 1.
- C. Media: Synthetic material on semi rigid backing constructed so individual pleats are maintained in tapered form under variable rated-airflow conditions by flexible internal supports.
- D. Configuration: 8 pocket at 24" width or equivalent.
- E. Filter-Media Frame: Galvanized steel.
- F. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- G. Capacities and Characteristics:
 - 1. Face Dimensions: As scheduled on plans.
 - 2. Thickness or Depth: As scheduled on plans.
 - 3. Surface Area: As scheduled on plans.
 - 4. System Airflow: As scheduled on plans.
 - 5. Maximum or Rated Face Velocity: 500 fpm.
 - 6. Initial Resistance: .46" and 500 fpm.
 - 7. Recommended Final Resistance: As scheduled on plans.
 - 8. MERV Rating: 14 when tested according to ASHRAE 52.2.

2.7 BULK MEDIA

- A. Description: Air-filter media, factory custom cut or rolled.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders Precisionaire Series 325T rolled media or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.

- B. Filter Unit Class: UL 900, Class 2.
- C. Media: Synthetic, in a roll or cut into pads.
 - 1. Pad Dimensions: As scheduled on plans.
- D. Capacities and Characteristics:
 - 1. Thickness or Depth: 1-1/2".
 - 2. System Airflow: As scheduled on plans.
 - 3. Maximum or Rated Face Velocity: 500 fpm.
 - 4. Arrestance: 93 percent when tested according to ASHRAE 52.1.
 - 5. Initial Resistance: .5".
 - 6. Recommended Final Resistance: 1".
 - 7. MERV Rating: 8 when tested according to ASHRAE 52.2.

2.8 FRONT- AND REAR-ACCESS FILTER FRAMES

- A. Framing System: Galvanized-steel framing members with access for either upstream (front) or downstream (rear) filter servicing, cut to size and pre-punched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders Precisionaire Model PF-1 Universal Holding Frame or comparable product by one of the following:
 - a. AAF International.
 - b. Camfil Farr.
- B. Pre-Filters: Incorporate a separate track with spring clips, removable from front or back.
- C. Sealing: Factory-installed, positive-sealing device for each row of filters, to ensure seal between gasketed filter elements and to prevent bypass of unfiltered air.
- D. Minimum 16 gauge galvanized steel construction.
- E. Frames for rows on higher shall be stiffened for manufacturer's guidelines.

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2.9 SIDE-SERVICE HOUSINGS

- A. Description: Factory-assembled, side-service housings, constructed of 16 gauge galvanized steel with flanges to connect to duct or casing system.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Flanders Precisionaire sure seal or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
- B. Pre-Filters: Integral tracks to accommodate 2-inch- deep, disposable filters.
- C. Access Doors: Hinged, with continuous gaskets on perimeter and positive-locking devices, and arranged so filter cartridges can be loaded from either access door.
- D. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames and to prevent bypass of unfiltered air.

2.10 FILTER GAGES

- A. Diaphragm-type gage with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Airguard.
 - b. Dwyer Instruments, Inc.
 - 2. Diameter: 4-1/2 inches.
 - 3. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5-Inch wg or Less: 0- to 0.5-inch wg.
 - 4. Scale Range for Filter Media Having a Recommended Final Resistance of 0.5- to 1.0-Inch wg or Less: 0- to 1.0-inch wg.
 - 5. Scale Range for Filter Media Having a Recommended Final Resistance of 1.0- to 2.0-Inch wg or Less: 0- to 2.0-inch wg.
 - 6. Scale Range for Filter Media Having a Recommended Final Resistance of 2.0- to 3.0-Inch wg or Less: 0- to 3.0-inch wg.
 - 7. Scale Range for Filter Media Having a Recommended Final Resistance of 3.0- to 4.0-Inch wg or Less: 0- to 4.0-inch wg.

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- B. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide one set of filters for construction and initial start-up, one set of filters for balancing, commissioning and air purging, and one set of filters for installation prior to final turnover of the units to the Owner and one set of spare filters for delivery to owner. Filters shall be as listed below:

- 1. Air-Handler & Air-Conditioning Units

- a. Construction and start-up
Pre-filter: FPF, MERV 13
Final Filter: None
 - b. Balancing, Commissioning and Purging
Pre-filter: PPF, MERV 13
Final filter: PF, MERV 13
 - c. Final Filters
Pre filter: PPF, MERV 8
Final filter: VBF, MERV 8

- 2. Heat Pump Units

- a. Construction and Startup
Final Filter: FPF, MERV 13
 - b. Balancing, Commissioning and Purging
Final Filter: FPF, MERV 13
 - c. Final Filters
Final Filter: PPF, MERV 13

- B. Units shall be bumped and preliminary startup activities shall occur with the construction filters in place. Filters may be shipped loose and shall be installed by this Contractor. Upon completion of the preliminary startup activities, and upon receipt of direction from the Construction Manager, this Contractor shall replace the construction filters with the second set of filters prior to testing, balancing and commissioning. This Contractor shall furnish and install the third set of filters immediately following Air Purging operations.

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- C. If the fan-powered terminal devices and/or fan coil units are operated by the General Contractor or the Mechanical Subcontractor during the construction period, the Mechanical Contractor shall install and maintain 1" thick glass fiber temporary air filters (MERV3) with frames on each air opening on each terminal and/or fan coil device until a Certificate of Substantial Completion is issued by the Owner. The temporary air filters on the fan powered terminal units or set up of the discharge fan flow by the Subcontractor if the FPTU utilizes the dynamics volume control sequences. The temporary filters shall be replaced after the completion of the balancing by the Mechanical Subcontractor. All temporary air filters shall be removed by the Mechanical Subcontractor after the Owner is given a two (2) week written notice and the filters are to be removed. If the construction filters are not maintained properly and regularly changed and the internal surfaces of the fan powered terminal devices become contaminated with dust and debris, the terminal units shall be thoroughly cleaned at no additional cost to the Owner.
- D. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- E. Install filters in position to prevent passage of unfiltered air.
- F. Install filter gage for each filter bank.
- G. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
- H. Coordinate filter installations with duct and air-handling-unit installations.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Test for leakage of unfiltered air while system is operating.
- D. Air filter will be considered defective if it does not pass tests and inspections.

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- E. Prepare test and inspection reports.

3.3 CLEANING

- A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION

SECTION 237313

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

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, and the following apply to this Section:
- B. Noise criteria for this section is referenced in specification section 230548.1. Vendor/manufacturer/contractor is responsible for this section 230548.1 in its entirety.
- C. Vibration and noise criteria for this vendor is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section in its entirety.

1.2 SUMMARY

- A. Section Includes:
 - 1. Variable-air-volume, single-zone air-handling units.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of $L/100$ where "L" is the unsupported span length within completed casings.

1.4 SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
 - 1. Unit dimensions and weight.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 - 3. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.

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- b. Certified fan-sound power ratings specific to unit configuration for project certified to ARI 260.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
 4. Certified coil-performance ratings with system operating conditions indicated in accordance with ARI 410.
 5. Dampers, including housings, linkages, and operators.
 6. Filters with performance characteristics.
- B. Delegated-Design Submittal: For vibration isolation and seismic restraints indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
- C. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
 2. Support location, type, and weight.
 3. Field measurements.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A, 90B and 255 for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: 410, 430, and 435.

- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
 - E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."
 - F. Comply with NFPA 70.
 - G. UL 723
- 1.6 COORDINATION
- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.
- 1.7 EXTRA MATERIALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: See section 2.5 for specific filter requirements.
 - 2. Gaskets: One set for each access door.
 - 3. Fan Belts: Two sets for each air-handling unit fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Carrier Corporation; a member of the United Technologies Corporation Family.
 - 2. Johnson Controls
 - 3. Trane
 - 4. AAON

2.2 INDOOR UNIT CASINGS

- A. General Fabrication Requirements for Casings:
 - 1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
 - 2. Casing Joints: Sheet metal screws or pop rivets.
 - 3. Sealing: Seal all joints with water-resistant sealant.

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4. Factory Finish for Galvanized-Steel Casings: Apply manufacturer's standard primer immediately after cleaning and pretreating.
5. Factory Finish for Galvanized-Steel Casings: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on enamel finish, consisting of prime coat and thermosetting topcoat.
6. Casing Coating: Thermoplastic vinyl Epoxy Zinc Synthetic resin Phenolic Polytetrafluoroethylene Vinyl ester Hot-dip galvanized Powder-baked enamel.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
8. All casings to be double wall construction.

B. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071, Type I.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the cooling-coil section.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service-air velocity.
3. Location and Application: Encased between outside and inside casing.

C. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:
 - a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
3. Access Doors:
 - a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
 - b. Gasket: Neoprene, applied around entire perimeters of panel frames.

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- c. Fabricate windows in all doors of double-glazed, wire-reinforced safety glass with an air space between panes and sealed with interior and exterior rubber seals.
 - d. Size: At least 18 inches 24 inches where section allows wide by full height of unit casing up to a maximum height of 72 inches.
 4. Locations and Applications:
 - a. Fan Section: Doors and inspection and access panels.
 - b. Access Section: Doors.
 - c. Coil Section: Inspection and access panel.
 - d. Damper Section: Doors.
 - e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
 - f. Mixing Section: Doors.
 - g. Humidifier Section: Doors.
 5. Service Light: 100-W vapor-proof fixture with switched junction box located outside adjacent to door, prewired to junction box.
 - a. Locations: Each section with door.
- D. Condensate Drain Pans:
 1. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
 - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1-2004.
 - b. Depth: A minimum of 2 inches deep.
 2. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 3. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - a. Minimum Connection Size: 1 ¼".
 4. Pan-Top Surface Coating: Asphaltic waterproofing compound.
 5. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- E. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.

2.3 FAN, DRIVE, AND MOTOR SECTION

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Horizontal-Flanged, Split Housing: Bolted construction.
 3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
 4. Flexible Connector: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized-steel sheet or 0.032-inch- thick aluminum sheets; select metal compatible with casing.
 - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, Coatings, and adhesives shall comply with UL 181, Class 1.
 - 1) Fabric Minimum Weight: 26 oz./sq. yd.
 - 2) Fabric Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3) Fabric Service Temperature: Minus 40 to plus 200 deg F.
 - b.
- C. Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.
- D. Fan Shaft Bearings:
1. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated life of 200,000 hours according to ABMA 9.
 2. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and 2-piece, cast-iron housing with grease lines extended to outside unit and a rated life of 200,000 hours according to ABMA 11.
 3. Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing with grease lines extended to outside unit.

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- E. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 2. Motor Pulleys: Adjustable pitch for use with 15-hp motors and smaller; fixed pitch for use with motors larger than 15- hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions, replace if required at no additional cost to meet field conditions.
 3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.
 4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch- thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.
- F. Variable-Inlet Vanes: Steel, with blades supported at both ends with permanently lubricated bearings. Variable mechanism terminating in single lever for connection to control actuator with connecting shaft for second set of variable inlet vanes on double-width fans.
- G. Discharge Dampers: Heavy-duty steel assembly with channel frame and sealed ball bearings, and opposed blades constructed of two plates formed around and welded to shaft, with blades linked out of air stream to single control lever.
- H. Internal Vibration Isolation and Seismic Control: Fans shall be factory mounted with manufacturer's standard restrained vibration isolation mounting devices having a minimum static deflection of 2 inches. Provide permanent tie down straps for units mounted on floating slabs – see plans for locations. Under no circumstance shall the tie down straps on those units be removed without written approval from the Acoustic Consultant.
1. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounting frame and air-handling-unit mounting frame are anchored to building structure.
- I. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Enclosure Type: Totally enclosed, fan cooled.
 2. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
 5. Mount unit-mounted disconnect switches on exterior of unit.
 6. Inverter duty motors for all systems with VFD's.

2.4 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with ARI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.
4. Seismic Fabrication Requirements: Fabricate coil section, internal mounting frame and attachment to coils, and other coil section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when coil-mounting frame and air-handling-unit mounting frame are anchored to building structure.

2.5 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:

1. Comply with NFPA 90A.
2. VAV Air handler
 - a. Construction and start-up
Pre filter: MERV 13
Final filter: None
 - b. Balancing, Commissioning and Purging
Pre filter: MERV 13
Final filter: MERV 13
 - c. Final filters
Pre filter: MERV 13
Final filter: MERV 13
 - d. Spare filters
Pre filter: MERV 13
Final filter: MERV 13
3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

2.6 DAMPERS

- ### A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed LOCFM per square foot at pressure differential.

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- B. Damper Operators: Comply with requirements in Division 23 Section "Instrumentation and Control for HVAC."
- C. Electronic Damper Operators Provided By BMS.
- D. Outdoor- and Return-Air Mixing Dampers: Parallel-blade, extruded-aluminum dampers mechanically fastened to cadmium-plated steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
- E. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, extruded-aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed -blade arrangement with cadmium-plated steel operating rods rotating in stainless-steel sleeve bearings mounted in a single extruded-aluminum frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.
- F. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.

2.7 CAPACITIES AND CHARACTERISTICS

- A. Indoor Casings:
 - 1. Outside Casing: Galvanized steel, minimum 16 gauge 0.064 inch thick.
 - 2. Inside Casing: Galvanized steel, solid, minimum 0.079 inch thick.
 - 3. Inside Casing at coil section: Stainless steel, solid, minimum 18 gauge.
 - 4. Floor Plate: Galvanized steel, minimum 0.064 inch thick.
 - 5. Floor Plate e coil section: Stainless steel, minimum 0.0625 inch thick.
 - 6. Insulation Thickness: 2 inches.
 - 7. Static-Pressure Classifications for Unit Sections before Fans: 6-inch wg.
 - 8. Static-Pressure Classifications for Unit Sections after Fans: 6-inch wg.
- B. Supply Fan:
 - 1. Per: AMCA 99-2408 class as indicated on schedule.
 - 2. Drive: V-belt.
 - 3. Type: As scheduled.
- C. Exhaust & Return Fan:
 - 1. Per: AMCA 99-2408, class as scheduled.
 - 2. Drive: V-belt.
 - 3. Type: As scheduled.
- D. Chilled and Hot Water coils:
 - 1. Capacities as scheduled on plans.
 - 2. Coil Type: Continuous circuit, Self-draining.

3. Piping Connections: Threaded, of coil.
4. Tube Material: Copper.
5. Tube Thickness: .020" Minimum
6. Fin Type: Plate.
7. Fin Material: Aluminum.
8. Fin Spacing: As scheduled on plans.
9. Fin Thickness: 0.0075" min.
10. Headers:
 - a. Cast iron with cleaning plugs and drain and air vent tappings extended to exterior of unit for 150 psig working pressure.
 - b. Heavy duty Type "K" copper header (0.95" wall) end caps for 151 psig to 350 psig system.
 - c. Provide insulated cover to conceal headers exposed outside casings.
11. Frames: Channel frame, 0.079-inch- thick galvanized steel 0.0625-inch- thick galvanized steel.
12. Coil Working-Pressure Ratings: 200 psig, 325 deg F.

E. Prefilters:

1. See Section 234100.

F. Final Filters:

1. See Section 234100.

G. UV Air Purifier

1. Provide unit with optional UV air purifier system,

2.8 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.
- D. Steam Coils: Factory tested to 300 psig and to 200 psig underwater according to ARI 410 and ASHRAE 33.
- E. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

2.9 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit.

PART 3 - EXECUTION

3.1 EXAMINATION – AIR HANDLING UNITS

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Equipment Mounting: Install air-handling unit using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Install galvanized-steel plate to equally distribute weight over elastomeric pad.
- B. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using NPS 1-1/4, ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

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- E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- F. Connect duct to air-handling units with flexible connections.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
 - 2. Charge refrigerant coils with refrigerant and test for leaks.
 - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Filter Operational Test: Operate filters to demonstrate compliance with requirements. Test for leakage of unfiltered air while system is operating.
 - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.

6. Verify that zone dampers fully open and close for each zone.
7. Verify that face-and-bypass dampers provide full face flow.
8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
9. Comb coil fins for parallel orientation.
10. Verify that proper thermal-overload protection is installed for electric coils.
11. Install new, clean filters.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION

SECTION 238126.1 - MULTIPLE EVAPORATOR DIRECT EXPANSION VARIABLE CAPACITY
SPLIT HEAT PUMP SYSTEMS (DAIKIN)

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.
- B. Vibration, wind & flood criteria for this vendor is referenced in specification Section 230548. Vendor/manufacturer/contractor is responsible for this section in its entirety.
- C. VOC Limits for Adhesives, Sealants, Paints and Coatings 018101
- D. Construction and Demolition Waste Management 017419
- E. Sustainable Design Requirement 018113
- F. Construction IAQ Management 018119
- G. Operating and Maintenance Paragraph 017823
- H. Commissioning 019100

1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of multiple evaporator-fan and compressor-condenser components.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics. Provide component part load, full load, cooling EER, IEER and heating cop @ 17°F, 47°F.
- B. LEED Submittals:
 - 1. Product Data for Credit EA 4: For refrigerants, documentation including printed statement that refrigerants are free of HCFCs.

- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- G. Warranty: Sample of special warranty.
- H. The submittal shall include equipment capacities at the design condition, power requirements, indoor units CFM/DVM static pressures, fan curves, installation requirements, refrigerant piping diagrams with all associated fittings, manifolds, distribution boxes and physical dimensions. Nominal performance data is no acceptable.
- I. The equipment supplier shall provide AutoCAD drawings to scale of all piping circuits, components, overall building control schematic, detailed control wiring diagrams, system, details and schedules for the system. The drawings shall convey all requirements to install the equipment to the manufacturer's requirements.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-Up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- D. Installation Requirements: They system must be installed by a manufacturer's factory-trained contractor/dealer. The bidders shall be required to submit training certification proof with bid documents. The mechanical contractor's installation price shall be based on the system's installation requirements and system engineering in accordance with manufacturer's requirements. The mechanical contractor bids with complete knowledge of the HVAC system requirements.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Ten (10) years from date of Substantial Completion.
 - b. For Parts: One (1) year from date of Substantial Completion.
 - c. For Labor: One (1) year from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set for each evaporator unit.

PART 2 - PRODUCTS

2.1 GENERAL SYSTEM DESCRIPTIONS

- A. System Description
 - 1. The variable capacity, heat recovery air-conditioning system shall be a Variable Refrigerant Volume Series (heat and cool model) system as specified. The system shall consist of multiple evaporators, branch selector boxes, joints and headers, a three-pipe refrigeration distribution system using PID control and VRV condenser unit. The condenser shall be a direct expansion (DX), air-cooled heat recovery, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant. The condensing unit may connect an indoor evaporator nominal capacity up to 200% of the condensing unit nominal capacity. All zones are each capable of operating separately with individual temperature control. A dedicated hot gas pipe shall be provided to ensure optimum heating operation performance. Two-pipe, heat recovery

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systems utilizing a lower temperature mixed liquid/gas refrigerant to perform heat recovery shall not be acceptable due to reduced heating capabilities.

2. The condensing unit shall be able to connect to indoor unit with the manufacturer's engineering data book detailing each available indoor unit. The indoor units shall be connected to the condensing unit utilizing manufacturer's specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.
3. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, an Intelligent Manager or a BMS interface.
4. The branch selector boxes shall have the capacity to control up to 290 MBH (cooling) downstream of the branch selector box. Each branch of the branch selector box shall consist of three electronic expansion valves, refrigerant control piping and electronics to facilitate communications between the box and the main processor and between the box and indoor units. The branch selector box shall control the operational mode of the subordinate indoor units. The use of three EEV's ensures continuous heating during defrost (multiple condenser systems), no heating impact during changeover and reduced sound levels. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.

B. Refrigerant Piping

1. The system shall be capable of refrigerant piping up to 540 actual feet or 620 equivalent feet from the condensing unit to the furthest indoor unit. A total combined liquid line length of 3,280 feet of piping between the condensing and indoor units 295 feet maximum vertical difference, without any oil traps. Manufacturer's piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance. Systems shall be capable of 98 ft (30m) vertical separation between indoor units.

2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Daikin Industries or comparable product by one of the following:
 1. LG Air Conditioning Technologies.
 2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
 3. SANYO North America Corporation; SANYO Fisher Company.
 4. Trane; a business of American Standard companies.

2.3 CEILING CASSETTE UNIT

- A. General: The indoor ceiling cassette fan coil unit, shall be operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grill. The supply air is distributed via motorized louvers, which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The indoor units sound pressure shall range from 27 dB (A) to 34 dB (A) at low speed measured at 5 feet below the unit.
- B. Performance: As scheduled on plans.
- C. Indoor Unit:
1. The unit shall be completely factory assembled and tested and include factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
 2. The indoor units shall be equipped with a condensate pan with antibacterial treatment and condensate pump. The condensate pump provides up to 33-1/2" of lift and has a built-in safety shutoff alarm.
 3. The indoor units shall be equipped with a return air thermistor.
 4. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
 5. The voltage range will be 253 volts maximum and 187 volts minimum.
- D. Unit Cabinet:
1. The cabinet shall be space saving and shall be located into the ceiling.
 2. Fresh air intake kit shall be provided.
 3. A branch duct knockout shall exist for branch ducting of supply air.
- E. Fan:
1. The fan shall be direct-drive turbo fan type with statically and dynamically-balanced impeller with three fan speeds available.
 2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with motor output range from 0.08 to 0.16 HP.
 3. The airflow rate shall be available in three settings.
 4. The fan motor shall be equipped as standard with adjustable External Static Pressure (ESP) settings to allow operation with the Daikin MERV 13 filter options.
 5. The fan motor shall be thermally protected.
- F. Filter:
1. High efficiency disposable MERV 13 filters shall be provided.

G. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2-row cross fin copper evaporator coil with 17 FPI design completely factory-tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-1/4 inch outside diameter PVC.
5. A condensate pan with antibacterial treatment shall be located under the coil.
6. A condensate pump with a 33-1/2 inch lift shall be located below the coil in the condensate pan with a built in safety alarm.
7. A thermistor will be located on the liquid and gas line.

H. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:

1. The unit shall have controls provided by equipment manufacturer to perform input functions necessary to operate the system.
2. The unit shall interface with Owner BMS system via manufacturer supplied BACnet gateway.
3. Unit controller for each zone shall be capable of follow set points:
 - a. Comfort Set Point Range 60-90°F (16 to 32°C).
 - b. Setback Set Point Range 40-95°F (5 to 35°C).
 - c. Operating Temp Range 14 to 122°F (-10 to 50°C).
 - d. Operating Humidity Range 75% or less (w/o condensation).
4. Unit controller shall be capable of:
 - a. Up to 16 indoor units are controllable in one group.
 - b. Can be combined with a secondary controller for dual operation.
 - c. Backlit LCD display in English, French, or Spanish.
 - d. Temperature sensor with configurable offset.
 - e. Display of Temperature and Set Point in 1°F/°C increments.
 - f. Three display modes Detailed, Standard and Simple.
 - g. Dual set points (individual cooling and heating set points) with minimum set point differential or single set point (occupied period).

- h. Set point range limits for Cooling and Heating.
- i. Independent cool/heat setback set points (unoccupied period).
- j. Auto changeover mode can automatically change to cool/heat mode at set point +/- 1°F (can be configured from 1 to 4°F using field settings) ignoring the guard timer.
- k. Built in 7, 5+2+1, and 1 (everyday) schedule with up to 5 actions per day with independent cool/heat or setback set points.
- l. Automatic adjustment for Daylight Savings Time (DST).
- m. 48-hour clock/calendar backup (in case of power failure).
- n. Constantly monitors the system for malfunctions with immediate display of fault location and condition.
- o. Prohibit buttons on remote controller.
- p. Limit selectable operation modes.
- q. Display can be configured not to show set point when unit is Off, instead of mode when unit is Off. Fan speed display removable.
- r. Backwards compatible.

J. Provide the following manufacturers' options:

- 1. Fresh air intake kit.
- 2. Fresh air relay kit to open/close fresh air damper with unit operation.

2.4 WALL-MOUNTED UNIT

- A. General: The indoor unit shall be a wall mounted fan coil unit, operable with refrigerant, R-410A, equipped with an electronic expansion valve, for installation onto a wall within a conditioned space. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with remote control. A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment. The indoor units sound pressure shall range from 31 dB(A) to 40 dB(A) at low speed measured at 3.3 feet below and from the unit.
- B. Performance: As scheduled on plans.
- C. Indoor Unit:
 - 1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The drainpipe can be fitted to from either left or right sides.

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2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. Return air shall be through a resin net mold resistant filter.
5. The indoor units shall be equipped with condensate pan.
6. The indoor units shall be equipped with a return air thermistor.
7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
8. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:

1. The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:

1. The fan shall be a direct-drive crossflow fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 0.054 to 0.058 HP.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.

F. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2-row cross fin copper evaporator coil with 14 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 11/16 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.
6. A condensate pan shall be located in the unit.

G. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:

1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a system multi-zone controller.

I. Optional Accessories Available:

1. Remote "in-room" sensor kit.
2. A built-in condensate pump.

2.5 FLOOR CONSOLE CONCEALED UNIT

- A. Unit shall be a floor-mounted console fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation within a conditioned space. It shall have a top discharge collar and filtered bottom return air. The cabinet can be mounted on the floor with refrigerant and condensate lines directed downward or affixed to the wall with horizontal refrigerant and condensate knockouts. Computerized PID control shall be used to control super heat to deliver a comfortable room temperature condition. A mold-resistant, resin net air filter shall be included. The indoor units sound pressure shall range from 35 dB (A) to 40 dB (A) at high speed measured at 5 feet away and 5 feet high. Unit capacities shall be as scheduled on plans.
- B. The indoor unit shall be completely factory-assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto swing louver which ensures efficient air distribution, which closes automatically when the unit stops.
- C. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
- D. Refrigerant lines shall be insulated from the outdoor unit.
- E. The indoor units shall be equipped with a return air thermistor.
- F. The indoor unit will be separately powered with 208~230V/1 phase/0Hz.
- G. The cabinet shall be affixed to a factory-supplied wall mounting template and located in the conditioned space.
- H. The cabinet shall be constructed with sound absorbing fiberglass urethane foam insulation.
- I. Fan: The fan shall be a direct drive Sirocco type fan, statically and dynamically balanced impeller with high and low fans speeds available.

- J. The fan motor shall operate on 208/230 volts, 1 phase, and 60 hertz with a motor output range 0.034 to 0.047 HP.
- K. The fan motor shall be thermally protected.
- L. Filter: the return air shall be filtered by means of disposal MERV 13 filter.
- M. Coil: Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance. The coil shall be a 3-row, cross fin copper evaporator coil with 17 fpi design completely factory tested. The refrigerant connections shall be flare connections and the condensate will be 27/32-inch outside diameter PVC. A thermistor will be located on the liquid and gas line.
- N. Control:
1. The unit shall have controls provided by equipment manufacturer to perform input functions necessary to operate the system.
 2. The unit shall interface with Owner BMS system via manufacturer supplied BACnet gateway.
 3. Unit controller for each zone shall be capable of follow set points:
 - a. Comfort Set Point Range 60-90°F (16 to 32°C).
 - b. Setback Set Point Range 40-95°F (5 to 35°C).
 - c. Operating Temp Range 14 to 122°F (-10 to 50°C).
 - d. Operating Humidity Range 75% or less (w/o condensation).
 4. Unit controller shall be capable of:
 - a. Up to 16 indoor units are controllable in one group.
 - b. Can be combined with a secondary controller for dual operation.
 - c. Backlit LCD display in English, French, or Spanish.
 - d. Temperature sensor with configurable offset.
 - e. Display of Temperature and Set Point in 1°F/°C increments.
 - f. Three display modes Detailed, Standard and Simple.
 - g. Dual set points (individual cooling and heating set points) with minimum set point differential or single set point (occupied period).
 - h. Set point range limits for Cooling and Heating.
 - i. Independent cool/heat setback set points (unoccupied period).
 - j. Auto changeover mode can automatically change to cool/heat mode at set point +/- 1°F (can be configured from 1 to 4°F using field settings) ignoring the guard timer.
 - k. Built-in 7, 5+2+1, and 1 (everyday) schedule with up to 5 actions per day with independent cool/heat or setback set points.
 - l. Automatic adjustment for Daylight Savings Time (DST).
 - m. 48-hour clock/calendar backup (in case of power failure).
 - n. Constantly monitoring the system for malfunctions with immediate display of fault location and condition.

- o. Prohibit buttons on remote controller.
 - p. Limit selectable operation modes.
 - q. Display can be configured not to show set point when unit is Off, instead of mode when unit is Off. Fan speed display removable.
 - r. Backwards compatible.
- O. Provide the following manufacturers' options:
- 1. Fresh air intake kit.
 - 2. Fresh air relay kit to open/close fresh air damper with unit operation.

2.6 VERTICAL AIR HANDLING UNITS

- A. Unit shall be floor-mounted vertical or horizontal right air handling unit, operable with refrigerant R-410A, equipped with an electronic expansion valve and direct-drive ECM type fan with auto CFM adjustment, for installation within a conditioned space. When installed in a vertical configuration, it shall have top discharge air and bottom return air. When installed in a horizontal right configuration, it shall have a horizontal discharge air and horizontal return air. A remote temperature sensor kit shall be required for all indoor units not utilizing the thermistor in the remote controller. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature.
- B. Unit capacities to be as scheduled on drawings.
- C. Indoor Unit:
- 1. The vertical air handlers' components shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, brazed connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
 - 2. Unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
 - 3. Both refrigerant lines shall be insulated from the outdoor unit.
 - 4. Return air shall be through a filter.
 - 5. Condensate draining shall be made via gravity or external condensate pump.
 - 6. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
 - 7. The voltage range will be 253 volts maximum and 187 volts minimum.
- D. Unit Cabinet:
- 1. The cabinet shall be constructed with sound absorbing, foil-faced insulation to control air leakage.
 - 2. Select an installation location with adequate structural support, space for service access and clearance for air return and supply duct connections.
 - 3. A field-supplied secondary drain pan shall be installed by Contractor.

E. Fan:

1. The fan shall be a direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 0.2 to 0.5 HP.
3. The airflow rate shall be available in high setting.
4. The fan motor shall be thermally protected.

F. Filter:

1. The return air shall be filtered by means of unit mounted MERV 8 disposable.

G. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 4-row cross fin copper evaporator coil with 15 fpi design completely factory-tested.
4. The refrigerant connections shall be brazed connections and the condensate will be ¾ inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

H. Control:

1. The unit shall have controls provided by equipment manufacturer to perform input functions necessary to operate the system.
2. The unit shall interface with Owner BMS system via manufacturer supplied BACnet gateway.
3. Unit controller for each zone shall be capable of follow set points:
 - a. Comfort Set Point Range 60-90°F (16 to 32°C).
 - b. Setback Set Point Range 40-95°F (5 to 35°C).
 - c. Operating Temp Range 14 to 122°F (-10 to 50°C).
 - d. Operating Humidity Range 75% or less (w/o condensation).
4. Unit controller shall be capable of:
 - a. Up to 16 indoor units are controllable in one group.
 - b. Can be combined with a secondary controller for dual operation.
 - c. Backlit LCD display in English, French, or Spanish.
 - d. Temperature sensor with configurable offset.
 - e. Display of Temperature and Set Point in 1°F/°C increments.
 - f. Three display modes Detailed, Standard and Simple.

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- g. Dual set points (individual cooling and heating set points) with minimum set point differential or single set point (occupied period).
 - h. Set point range limits for Cooling and Heating.
 - i. Independent cool/heat setback set points (unoccupied period).
 - j. Auto changeover mode can automatically change to cool/heat mode at set point +/- 1°F (can be configured from 1 to 4°F using field settings) ignoring the guard timer.
 - k. Built in 7, 5+2+1, and 1 (everyday) schedule with up to 5 actions per day with independent cool/heat or setback set points.
 - l. Automatic adjustment for Daylight Savings Time (DST).
 - m. 48-hour clock/calendar backup (in case of power failure).
 - n. Constantly monitoring the system for malfunctions with immediate display of fault location and condition.
 - o. Prohibit buttons on remote controller.
 - p. Limit selectable operation modes.
 - q. Display can be configured not to show set point when unit is Off, instead of mode when unit is Off. Fan speed display removable.
 - r. Backwards compatible.
- I. Provide the following manufacturers' options:
- 1. Fresh air intake kit.
 - 2. Fresh air relay kit to open/close fresh air damper with unit operation.

2.7 CONCEALED CEILING DUCTED UNIT

- A. General: Provide concealed fan coil units operable with refrigerant R-410A, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. It is constructed of galvanized steel casing. It shall be a horizontal discharge air with horizontal return air configuration. Computerized PID control shall be used to control superheat to meet room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. The indoor unit sound pressure shall range from 29 dB(A) to 40 dB(A) at low speed measured 5 feet below the ducted unit.
- B. Unit
- 1. Each unit shall include factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused tie delay, and test run switch.
 - 2. The indoor units shall be equipped with a return air thermistor.
 - 3. The indoor unit will be separately powered with 208~230V/1 phase/60Hz.
 - 4. The voltage range will be 253 volts maximum and 187 volts minimum.
- C. Unit Cabinet:

1. The cabinet shall be located in the ceiling and have supply and return duct collars.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

D. Fan:

1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
2. The unit shall be equipped with automatically adjusting external static pressure logic selectable during commissioning.
3. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range of 0.12 to 0.47 HP respectively.
4. The fan motor shall be thermally protected.
5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.

E. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3-row cross fin copper evaporator coil with 13 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-1/4" outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

F. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

G. Control:

1. The unit shall have controls provided by equipment manufacturer to perform input functions necessary to operate the system.
2. The unit shall interface with Owner BMS system via manufacturer supplied BACnet gateway.
3. Unit controller for each zone shall be capable of the following set points:
 - a. Comfort Set Point Range 60-90°F (16 to 32°C).
 - b. Setback Set Point Range 40-95°F (5 to 35°C).

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- c. Operating Temp Range 14 to 122°F (-10 to 50°C).
 - d. Operating Humidity Range 75% or less (w/o condensation).
4. Unit controller shall be capable of:
- a. Up to 16 indoor units are controllable in one group.
 - b. Can be combined with a secondary controller for dual operation.
 - c. Backlit LCD display in English, French, or Spanish.
 - d. Temperature sensor with configurable offset.
 - e. Display of Temperature and Set Point in 1°F/°C increments.
 - f. Three display modes Detailed, Standard and Simple.
 - g. Dual set points (individual cooling and heating set points) with minimum set point differential or single set point (occupied period).
 - h. Set point range limits for Cooling and Heating.
 - i. Independent cool/heat setback set points (unoccupied period).
 - j. Auto changeover mode can automatically change to cool/heat mode at set point +/- 1°F (can be configured from 1 to 4°F using field settings) ignoring the guard timer.
 - k. Built in 7, 5+2+1, and 1 (Everyday) schedule with up to 5 actions per day with independent cool/heat or setback set points.
 - l. Automatic adjustment for Daylight Savings Time (DST).
 - m. 48-hour clock/calendar backup (in case of power failure).
 - n. Constantly monitoring the system for malfunctions with immediate display of fault location and condition.
 - o. Prohibit buttons on remote controller.
 - p. Limit selectable operation modes.
 - q. Display can be configured not to show set point when unit is Off, instead of mode when unit is off. Fan speed display removable.
 - r. Backwards compatible.
- H. Provide the following manufacturers' options:
- 1. Fresh air intake kit.
 - 2. Fresh air relay kit to open/close fresh air damper with unit operation.

2.8 OUTDOOR AIR-COOLED CONDENSING UNITS

- A. General: The condensing unit shall be designed specifically for use with the indoor evaporators.
- 1. The condensing unit is designed specifically for use with VRV series components.
 - 2. The condensing unit shall be factory-assembled in the USA and pre-wired with all necessary electronic and refrigerant controls.
 - 3. The refrigeration circuit of the condensing unit shall consist of Daikin inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, liquid receiver and suction accumulator.

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4. High/low pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.
5. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
6. The connection ratio of indoor units to condensing unit shall be permitted up to 200% of nominal capacity.
7. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.
8. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night-time or via an external output.
9. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
10. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
11. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and anti-recycling timers.
12. To ensure the liquid refrigerant does not flash when supplying various indoor units, the circuit shall be provided with a sub-cooling feature.
13. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation. Each system shall maintain continuous heating during oil return operation.
14. The condensing unit shall be capable of heating operation at -13°F (-25°C) wet bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
15. The multiple condenser VRV systems shall continue to provide heat to the indoor units in heating operation while in defrost mode.
16. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.
17. Defrost Heating – Multiple condenser VRV systems shall maintain continuous heating during defrost operation. Reverse cycle (cooling mode) defrost operation shall not be permitted due to the potential reduction in space temperature.
18. Configurator Software – Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes. If this software is not provided by an alternate manufacturer for each individual outdoor unit, the contractor shall do settings manually and keep detailed records for future maintenance purposes.

B. Unit Cabinet:

1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust proofed mild steel panels coated with a baked enamel finish.

C. Fan:

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1. The condensing unit shall consist of one or more propeller type, direct-drive 800W fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
3. The condensing unit shall have configurable settings for intermittent fan operation to help minimize snow accumulation on fan blades when the system is off.
4. The fan shall be a vertical discharge configuration with a nominal airflow maximum range of 7,283 CFM to 28,440 CFM dependent on model specified.
5. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
6. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
7. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps as shown below.

Operation Sound dB(A)	Night Mode Sound Pressure Level dB(A)
Step 1 Max.	55
Step 2 Max.	50
Step 3 Max.	45

D. Condenser Coil:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to for a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an ePass Design.
4. The fins are to be covered with an anti-corrosion hydrophylic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM B117 test standards.
5. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during operation enhancing the defrost operation. An alternate manufacturer must provide a drain pan heater to enable adequate defrosting of the unit in defrost operation.
6. The condensing unit shall be factory equipped with condenser coil guards on all sides.

E. Compressor:

1. The inverter injection scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.

2. The inverter-driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically-sealed scroll "K-type".
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type.
4. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
5. The capacity control range shall be as low as 3% to 100%.
6. The compressor's motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
7. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
8. Oil separators shall be standard with the equipment together with an intelligent oil management system.
9. The compressor shall be mounted on vibration dampening rubber grommets to minimize the transmission of vibration, eliminating the standard need for external spring isolation. In the event of compressor failure, the remaining compressors, if applicable, shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifold systems.
10. In the case of multiple condenser modules, combined operation hours of the compressors shall be balanced by means of Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system, sequential start is activated for all system on each DIII network.

F. Electrical:

1. The power supply to the condensing unit shall be 208-230 volts, 3 phase, 60 hertz +/- 10%.
2. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.
3. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.
4. The control wiring maximum lengths shall be 6560 ft (2000m); condenser to central controller: 3280 ft (1000m); indoor unit to remote control: 1640 ft (500m). Wire type shall be 16/18 AWG, 2 wire, non-polarity, non-shielded, stranded

2.9 INDOOR WATER-COOLED CONDENSING UNIT

A. General: The condensing unit is designed specifically for use with VRV-WIII series components.

1. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin scroll compressors, motors, brazed plate heat exchanger, electronic

expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and liquid receivers. Discharge pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.

2. The connection ratio of indoor units to condensing unit shall be permitted up to 130%.
3. Each condensing system shall be able to support the connection of up to 32 indoor units, dependent on the model of the condensing unit.
4. System shall have an operable flow rate range of 13.2-40.0 gpm per module for standard operation and 21-40 gpm for geothermal operation.
5. System shall have an operating inlet water temperature range of 50°F - 113°F for standard operation and down to 27°F in cooling and 14°F in heating for geothermal operation the sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit.

Model Number	Sound Pressure Level dB(A)
RWEYQ72PTJU	50
RWEYQ84PTJU	51
RWEYQ144PTJU	53
RWEYQ168PTJU	54
RWEYQ216PTJU	56
RWEYQ252PTJU	57

6. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
7. Each condensing unit shall have a 240VAC, 0.3mA-0.5A control circuit output for water pump or isolation valve operation. This circuit shall be configured at commissioning to operate based on system or compressor operation.
8. Each condensing unit shall incorporate normally open, 15VDC and 1.0mA rated contacts for integration of a mandatory flow proving device.
9. Each condensing unit shall incorporate contacts for electrical demand shedding from a central BMS, utility control or demand meter.
10. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
11. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heater, fusible plug, overload relay, inverter overload protector, thermal protector for compressor motor, over current protection for the inverter and anti-recycling timer.
12. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
13. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.

B. Unit Cabinet:

1. The condensing unit shall be corrosion resistant. The unit shall be constructed from rust-proofed, mild steel panels coated with a baked enamel finish.

C. Condenser heat Exchanger:

1. The condenser heat exchanger shall be a stainless brazed plate type designed for closed loop/dry cooler applications. Coaxial type designed for closed loop/dry cooler applications. Coaxial type heat exchangers shall not be acceptable.
2. The heat exchanger shall use 1-1/4" FPT inlet piping.
3. The heat exchanger shall use 1-1/4" FPT outlet piping.
4. The heat exchanger shall use 1/2" FPS drain piping.
5. The heat exchanger shall have a maximum system water pressure of 285 psi (equivalent to 640 ft of head).

D. Compressor:

1. The Daikin inverter scroll compressors shall be variable speed (PWM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.
2. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll "G-type" with a maximum speed of 6,450 rpm.
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 8% to 100%.
5. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
6. Oil separators shall be standard with the equipment together with an intelligent oil management system.
7. The compressor shall be spring mounted to avoid the transmission of vibration.
8. Units sized 6-7 ton shall contain 1 compressor, 12-14 ton units shall contain 2 compressors and 18-21 ton units shall contain 3 compressors. In the event of compressor failure the remaining compressors shall continue to operate and provide heating or cooling as required at proportionally reduce capacity. The microprocessor and associated controls shall be designed to specifically address this condition.
9. In the case of multiple condenser modules, conjoined operating hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle or every 8 hours.

E. Electrical:

1. The power supply to the outdoor unit shall be 208/230 volts, 3 phase, 60 hertz +/- 10%.
2. The control voltage between the indoor and outdoor unit shall be 18VDC non-shielded, stranded 2 conductor cable.
3. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one outdoor unit with one 2-cable wire, thus simplifying the wiring operation.

2.10 REFRIGERANT BRANCH SELECTOR BOX FOR HEAT RECOVERY SYSTEM

- A. General: The branch selector boxes shall be designed specifically for use with VRV IV series heat recovery system components. These selector boxes shall be factory assembled, wired, and piped. These selector boxes must be mounted indoors. When simultaneously heating and cooling, the units in heating mode shall energize their sub-cooling electronic expansion valve. The number of connectable indoor units shall be in accordance with manufacturer's guidelines. The unit shall not require condensate removal.

Model Number	Maximum Connectable Cooling Capacity	Maximum Number of Connectable Indoor Units per Branch
BSQ36TVJ	36,000 Btu/h	4
BSQ60TVJ	60,000 Btu/h	8
BSQ96TVJ	96,000 Btu/h	8
BS4Q54TVJ	144,000 Btu/h	5
BS6Q54TVJ	216,000 Btu/h	5
BS8Q54TJV	290,000 Btu/h	5
BS10Q54TJV	290,000 Btu/h	5
BS12Q54TJV	290,000 Btu/h	5

- B. Unit Cabinet: These units shall have a galvanized steel plate casing. Each cabinet shall house 3 electronic expansion valves for refrigerant control per branch. The cabinet shall contain one sub-cooling heat exchanger per branch. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene. Nominal sound pressure levels must not exceed the values below:

Model Number	Sound Level dB(A) Operation	Sound Level dB(A) Max
BSQ36TVJ	35	40
BSQ60TVJ	41	45
BSQ96TVJ	41	45

BS4Q54TVJ	38	45
BS6Q54TVJ	39	47
BS8Q54TJV	39	47
BS10Q54TJV	40	48
BS12Q54TJV	40	48

- C. Refrigerant Valves: The unit shall be furnished with 3 electronic expansion valves per branch to control the direction of refrigerant flow. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise. The refrigerant connections must be of the braze type. In multi-port units, each port shall have its own electronic expansion valves. If common expansion/solenoid valves are used, redundancy must be provided. Multiple indoor units may be connected to a branch selector box with the use of a manufacturer joint provided there are within the capacity range of the branch selector.
- D. Condensate Removal: The unit shall require provisions for condensate removal. A safety device or secondary drain pan shall be installed by the mechanical contractor to comply with the applicable mechanical code, if an alternate manufacturer is selected.
- E. Electrical: The unit electrical power shall be 208/230 volts, 1 phase, and 60 hertz. The unit shall be capable of operation within the limits of 187 volts to 255 volts. The minimum circuit amps (MCA) shall be 0.1 and the maximum overcurrent protection (MOP) amps shall be 15. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

2.11 INTELLIGENT TOUCH MANAGER (iTM) CENTRAL CONTROLLER NETWORK WIRING

A. General: Network

The VRV Controls shall be made up of local remote controllers, a centralized controller, and open protocol network devices that transmit information via the communication bus. The VRV Controls Network shall have the ability to be accessed via a networked PC. The VRV Controls Network shall support operation monitoring, scheduling, error e-mail distribution, general user software, tenant billing, maintenance support, and integration with Building Management Systems (BMS) using open protocol via BACnet®.

B. Electrical Characteristics

- 1. General: The controller will require 24 VAC to power the controller. The multi-zone controller shall supply 16 volts DC to the communication bus. The voltage may rise or fall in relation to the transmission packets that are sent and received. The Centralized Controller shall provide control for all units and a maximum of 64 indoor unit groups and 128 indoor units connected to a maximum of 10 outdoor units. The centralized Controller shall support operations superseding that of the local remote controller, system

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configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.

2. Wiring: The centralized controller communication wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to branch selector, then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit. The termination of the wiring shall be non-polar. The remote-control wiring shall run from the indoor unit control terminal block to the remote controller connected with that indoor unit.
3. Wiring Size: Wiring shall be non-shielded, 2-conductor sheathed vinyl cord or cable, and 18 AWG stranded copper wire.

C. Intelligent Touch Manager (iTM) (DCM601A71)

1. The intelligent Touch Manager (Version 2.04) shall provide control for all VRV, SkyAir, and Daikin RA and FTXS indoor units with the use of the KRP928BB2S RA Adapter. It shall be capable of controlling a maximum of 64 indoor unit groups and 128 indoor units connected to a maximum of 10 outdoor units. The intelligent Touch Manager shall support operations superseding that of the local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.
2. The controller wiring shall consist of a non-polar two-wire connection to the indoor unit at terminals F1F2 (out-out) of the outdoor unit. The intelligent Touch Manager is wall-mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s).
3. The intelligent Touch Manager (iTM) can be used in conjunction with the BRC1E73 (Navigation Remote Controller), the BRC2A71 (Simplified Remote Controller), or the BRC4C82/7E83/7C812/7E818 (Wireless Remote Controller), BACnet interface, Lonworks interface, and Modbus adapter to control the same indoor unit groups. The remote controller shall require daisy chain wiring for grouping multiple indoor units (up to 16) together. Manual addressing is required of each remote controller group associated with the intelligent Touch Manager. DIII-NET address can be set for one (1) indoor unit or each indoor unit in the remote controller group. No more than 2 remote controllers can be placed in the same group.
4. The intelligent Touch Manager shall be equipped with two RJ-45 Ethernet ports for 100 Mbps network communication to support interconnection with a network PC via the Internet, Local Area Network (LAN), or connection with a non-networked PC after completed installation.
5. Web access functions shall be available so that facility staff can securely log into each intelligent Touch Manager via the PC's web browser to support monitoring, scheduling, error recognition, and general user functions. Error emails are also sent to designated email addresses. An additional optional software function Power Proportional Distribution (PPD) tenant billing shall also be available. The optional software shall require advanced purchase and can only be activated upon receipt of a license activation key from Daikin AC.
6. Mounting
 - a. The intelligent Touch Manager shall be mounted on the wall or into the mounting fixtures included with the intelligent Touch Manager.

7. Display Features

- a. The intelligent Touch Manager shall be approximately 11.42" x 9.57" x 1.97' in size with a backlit 10.4" LCD display.
- b. Display information shall be selectable from English, French, Italian, Korean, Dutch, Portuguese, Chinese, Japanese, German, or Spanish.
- c. Featured backlit LCD with auto off after 30 minutes (default) is adjustable between 1 to 60 minutes, or the choice of 3 different screen savers.
- d. Area and Group Configuration
 - 1) Area contains one (1) or more Area(s) or Group(s)
 - 2) A Group may be an indoor unit, Di, Dio point that has a DIII-Net address.
 - 3) A Group may be an external management point such as a Di, Do, Bi, Bo, Bv, Ai, Ao, Av, Mi, Mo, Mv that does not have a DIII-Net address.
- e. An Area is a tiered group where management points (indoor unit, digital input/output, and analog input/output groups) can be monitored and controlled by global settings. Up to 650 Areas can be created. Area hierarchy can have up to 10 tiered levels (ex., top level: 1st Floor West, 2nd level: offices, hallways, 3rd level: Office 101, 102, and 103, etc.). Area configuration shall classify levels of monitoring and control for each management point.
 - 1) Areas and Groups may be assigned names (ex., Office 101, Lobby, North Hallway, etc.)
- f. The Controller shall display On/Off, Operation Mode, Set point, Space Temperature, Louver Position, Fan Speed for each Area or Group.
- g. The Controller shall display Date (MM/DD/YYYY, YYYY/MM/DD, or DD/MM/YYYY format selectable) and day of the week along with the time of day (12 hr or 24 hr display selectable).
- h. The Controller shall adjust for Daylight Savings Time (DST) automatically.
- i. Display information shall be updated every 3 seconds to show the latest status of the indoor unit groups.
- j. System status icons shall display On/Off (color-coded), Malfunction/Error (color-coded), Forced Stop, Setback, Filter, Maintenance, and Screen Lock.
- k. The controller shall display the temperature set point in one-degree increments with a range of 60°F - 90°F, 1°F basis (16°C - 32°C, 0.1°C basis).
 - 1) Display of temperature set point information shall be configurable for Fahrenheit or Celsius.
- l. Display shall reflect room temperature in one tenth degree increments with a range of -58°F - 248°F, 0.1°F basis (-50°C - 120°C, 0.1°C basis) with 0.1°C accuracy.
 - 1) Display of room temperature information shall be configurable for Fahrenheit or Celsius.

- m. The Menu List shall be used to configure options and display information for each Area or Group.
 - n. Error status shall be displayed in the event of system abnormality/error with one of three color-coded icons placed over the indoor unit icon or lower task bar.
 - 1) System errors are generated when the intelligent Touch Manager system with other VRV controls systems are combined incorrectly or power proportional distribution calculation errors occur. The intelligent Touch Manager shall display the error with a red triangle placed on the lower task bar.
 - 2) Unit errors occurring within the VRV system shall be displayed with a yellow triangle placed over the indoor unit icon.
 - 3) Limit errors are based upon pre-configured analog input upper and lower limit settings and are generated when the limits have been met. When limit error is generated a yellow triangle will be placed over the unit icon.
 - 4) Communication errors between the intelligent Touch Manager and the indoor units shall be displayed with a blue triangle placed over the indoor unit icon.
 - 5) Error history shall be available for viewing for up to 500,000 errors/abnormality events with operation events.
8. Layout View
- a. Capable of displaying site floor plan or Graphical User Interface (GUI) as the background for visual navigation. Indoor unit, DIII-Net Di and Dio, and External Di, Do, Ai, Ao, Av, Mi, Mo, Mv icons with operational status can be placed on the floor layout or GUI.
 - 1) Up to 4 status points can be assigned to the indoor unit icon (room name, room temperature, set point, and mode).
 - 2) Digital input and output icons will display On/Off status.
 - 3) Analog icons will display Ai, Ao and Av.
 - 4) Multistate icons will display Mi, Mo and Mv.
 - a) Up to 60 floor layout sections can be created.
9. Basic Operation
- a. Capable of controlling by Area(s) or Group(s).
 - b. Controller shall control the following group operations:
 - 1) On/Off.
 - 2) Operation Mode (Cool, Heat, Fan, Dry, and Auto).
 - 3) Independent Cool and Heat dual Set points or single Set point for current mode in the occupied period.

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- 4) Controller shall be able to limit the user adjustable set point ranges individually for cooling and heating based upon the Area or Group configurations.
 - 5) Independent Setup (Cooling) and Setback (Heating) set points in the unoccupied mode adjustable to 50 - 95°F.
 - a) Setup and Setback set points can only be set outside of the occupied set point range.
 - b) The Setup and Setback set points will automatically maintain a 2°F fixed differential from the highest possible occupied set points.
 - c) The recovery differential shall be 4°F (default) and adjustable between 2 - 10°F.
 - d) Settings shall be applied based upon the Area or Group configurations.
 - 6) Fan Speed
 - a) Up to 3 speeds (dependent upon indoor unit type).
 - 7) Airflow direction (dependent upon indoor unit type).
 - a) 5 fixed positions or oscillating.
 - 8) Remote controller permit/prohibit of On/Off, Mode, and Set Point.
 - 9) Lock out setting for Intelligent Touch Manager display.
 - 10) Indoor unit Group/Area assignment.
- c. Capable of providing battery backup power for the clock at least 1 year when no AC power is applied.
- 1) The battery can last at least 13 years when AC power is applied.
 - 2) Settings stored in non-volatile memory.

10. Programmability

- a. Controller shall support weekly schedule settings
 - 1) 7 day weekly pattern (7)
 - 2) Weekday + Weekend (5 + 2)
 - 3) Weekday + Saturday + Sunday (5 + 1 + 1)
 - 4) Every day (1)
 - 5) The schedule shall have the capabilities of being enabled or disabled.
 - 6) 100 independent schedules configurable with up to 20 events settable for each days schedule.
 - a) Each scheduled event shall specify time and target Area or Group.
 - b) Each scheduled event shall include On/Off, Optimum Start, Operation Mode, Occupied Set points, Setback Set points, Remote Controller

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On/Off Prohibit, Remote Controller Mode Prohibit, Remote Controller Set Point Prohibit, Timer Extension Setting, Fan Speed, and Set point Range Limit.

- (1) Set point when unit is On (occupied)
 - (2) Configurable Setup (Cooling) and Setback (Heating) set points when unit is Off (unoccupied)
- c) Time setting in 1-minute increments.
 - d) Timer Extension shall be used for a timed override (settable from 30 - 180 minutes) to allow indoor unit operation during the unoccupied period.
- 7) A maximum of 40 exception days can be schedule on the yearly schedule (repeats yearly).
- a) Exception days shall be used to override specified days on the weekly schedule based upon irregular occupied/unoccupied conditions.
 - b) Exception days can be configured on a set date (Jan 1) or floating date (1st Monday in September).
- b. Controller shall support auto-changeover.
- 1) Auto-change shall provide Fixed (default), Individual, Averaging, and Vote changeover methods for both Heat Pump and Heat Recovery systems based upon the changeover group configuration. This will allow for the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat in accordance with the room temperature and set point. The following changeover scheme shall be applicable to the Fixed, Individual, and Averaging methods.
 - a) Changeover to cooling mode shall occur at cooling set point +1°F (0.5°C) as the primary changeover deadband and takes the guard timer into consideration.
 - (1) Configurable from 1 - 4°F (0.5 - 2°C)
 - b) Changeover to cooling mode shall occur at the primary changeover deadband to cooling +1°F (0.5°C) as the secondary changeover deadband.
 - (1) Configurable from 1 - 4°F (0.5 - 2°C)
 - c) Changeover to heating mode shall occur at heating set point - 1°F (0.5°C) as the primary changeover deadband and takes the guard timer into consideration.

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- d) Changeover to heating mode shall occur at the primary changeover deadband to heating -1°F (0.5°C) as the secondary changeover deadband.
 - (1) Configurable from $1 - 4^{\circ}\text{F}$ ($0.5 - 2^{\circ}\text{C}$)
 - e) A weighted demand shall be configurable for the Averaging and Vote methods.
- 2) Fixed Method
- a) Changeover evaluated by room temperature and set point of the representative indoor unit (first registered indoor unit in changeover group) in the changeover group even when it is not operating (must be in Cool, Heat, or Auto mode).
 - b) Changeover affects all indoor unit groups in the changeover group.
- 3) Individual Method (recommended for Heat Recovery Systems)
- a) Changeover evaluated by room temperature and set points of the individual indoor unit group in the changeover group.
 - b) Changeover affects individual indoor unit group in the changeover group.
- 4) Average Method
- a) Changeover evaluated by the average of all indoor unit group's room temperatures and set points operating in Cool, Heat, or Auto mode in the changeover group list.
 - b) If none of the indoor units in the group meet the above requirements the fixed method of changeover will be applied.
 - c) A weighted demand (0 - 3) can be configured for each indoor unit in the changeover group.
 - d) Changeover affects all indoor unit groups in the changeover group.
- 5) Vote Method
- a) In each indoor unit, the cooling demand is calculated based upon the difference between the room temperature and cooling set point. If the room temperature falls below the primary cool changeover point (cool set point plus the primary changeover deadband), the cooling demand is considered as 0 (zero). Then the total cooling demand is calculated as the sum of each indoor unit's cooling demand.
 - b) The opposite is true for the total heating demand.
 - c) A weight (0 - 3) can be added to each indoor unit's demand in the changeover group. The default setting is 1.

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- d) The weight 0 (zero) means the indoor unit's demand is not added in the total demand, so the indoor unit's demand is considered to be 0 (zero).
 - e) The weight 2 or 3 means the indoor unit's demand is added 2 or 3 times in the total demand, respectively.
 - f) Changeover to cooling mode shall occur when the total cooling demand is greater than the total heating demand.
 - g) The opposite is true for changeover to heating.
 - h) Vote supports a Heating Override option, which prioritizes switching to the heating mode if at least one room temperature falls below the secondary heat changeover point (heat set point minus the secondary changeover deadband) even if the total cooling demand is greater than the total heating demand.
 - i) Changeover affects all indoor unit groups in the changeover group.
- 6) Changeover shall change the operation mode of the indoor unit that is set as the Changeover Master. The Changeover Master indoor unit shall then change the operation mode of all indoor unit groups daisy chained to the same outdoor unit in the Heat Pump system or branch selector box in the Heat Recovery system.
- 7) Guard Timer
- a) Upon changeover, guard timer will prevent another changeover during the guard timer activation period (15, 30, 60 (default) min.).
 - b) Guard timer is ignored by a change of set point manually from either intelligent Touch Manger (iTM) or Remote Controller, by schedule, or the room temperature meets or exceeds the secondary changeover deadband of the mode opposite of the current mode setting.
- c. Controller shall support Interlock.
- 1) Interlock feature for use with 3rd party equipment (DOAS, dampers, occupancy sensing, etc.) to automatically control Groups or Areas corresponding to the change of the operation states or the On/Off states of any Group.
 - 2) WAGO I/O Unit – Di, Do, Ai, Ao
 - a) On/Off based monitoring and control of equipment.
 - b) Manual or scheduled operation of equipment.
 - c) Operation based upon interlock with management points (group(s)).
 - d) Monitor equipment error/alarm status.
 - 3) Digital Input/Output (DEC102A51-US2) unit or Digital Input (DEC101A51-US2) unit
 - a) On/Off based monitoring and control of equipment.
 - b) Manual or scheduled operation of equipment.

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- c) Operation based upon interlock with management points (group(s)).
 - d) Monitor equipment error/alarm status.
 - d. Controller shall support force shutdown of associated indoor unit groups.
- 11. Web/Email Function
 - a. Each intelligent Touch Manager shall be capable of monitoring, operating, and scheduling a maximum of 64 indoor unit groups (up to 512 indoor unit groups with the addition of the iTM Plus Adapter) from a networked PC's web browser. It shall also be capable of creating general user access and sending detailed error emails to a customized distribution list (up to 10 email addresses).
 - b. All PCs shall be field supplied.
- 12. Optional Software
 - a. Power Proportional Distribution (PPD) – (DCM002A71)
 - 1) The tenant billing option shall be capable of calculating VRV Controls Network equipment energy usage in kWh based on the energy consumption of the outdoor unit(s) divided among the associated indoor units. This software is used in conjunction with the intelligent Touch Manager and a Watt Hour Meter (WHM). A maximum of 3 Watt Hour Meters can be connected to the intelligent Touch Manager. Up to 4 additional Watt Hour Meters can be connected to each iTM Plus Adapter, and up to 7 iTM Plus Adapters can be connected to the intelligent Touch Manager.
 - 2) The Power Proportional Distribution results data can be saved to a USB flash drive, or on a PC with the use of the web access. Data is saved in the CSV format. Results can be stored up to 13 months in the intelligent Touch Manager.
- D. BACnet Client Option (DCM009A51)
 - 1. The iTM BACnet Client Option shall be capable of making the intelligent Touch Manager work as a BACnet client using the BACnet/IP protocol. A BACnet client machine is able to send service requests to a BACnet server machine that then performs the services and reports the results to the client. By registering equipment and sensors connected to a BACnet server as management points, equipment and sensors can be monitored and controlled by the intelligent Touch Manager. The BACnet Client option must be enabled/activated in each intelligent Touch Manager to be used.
 - 2. System Capacity
 - a. A maximum of 50 BACnet servers can be monitored and/or controlled by one intelligent Touch Manager.
 - b. A maximum of 1536 objects can be monitored and/or controlled by one intelligent Touch Manager.

- c. A maximum of 512 management points, including BACnet management points, external management points, internal Ai management points, AHU management points, and Chiller management points, can be registered in one intelligent Touch Manager.
3. Objects that can be used in BACnet management points are:
 - a. Analog Input (Object Type Number 0)
 - b. Analog Output (Object Type Number 1)
 - c. Analog Value (Object Type Number 2)
 - d. Binary Input (Object Type Number 3)
 - e. Binary Output (Object Type Number 4)
 - f. Binary Value (Object Type Number 5)
 - g. Multi-Sate Input (Object Type Number 13)
 - h. Multi-Sate Output (Object Type Number 14)
 - i. Multi-Sate Value (Object Type Number 19)
 4. BACnet Server Gateway Option (DCM014A51)
 - a. The iTM BACnet Server Gateway Option shall be capable of making the intelligent Touch Manager work as a BACnet gateway using the BACnet/IP protocol. The iTM BACnet Server Gateway Option shall be capable of exposing indoor unit management points as BACnet objects to the (BMS). The iTM BACnet Server/Gateway Option shall be capable of allowing the BMS to monitor and control indoor units BACnet objects.
 - b. The iTM BACnet Server Gateway Option shall be compatible with VRV, SkyAir, Outdoor Air Processing Unit, Mini-Split system with use of KRP928, and FFQ indoor unit for Multi-split system.
 - c. Functions
 - 1) The iTM BACnet Server Gateway Option shall be capable of supporting Change of Value (CoV) notification.
 - 2) The iTM BACnet Server Gateway Option shall communicate to BMS using port number 47808 (configurable).
 - 3) The iTM BACnet Server Gateway Option shall function as BACnet router to provide unique virtual BACnet device identification number (ID) for every indoor unit group address.
 - 4) The iTM BACnet Server Gateway Option shall provide configurable BACnet Network number.
 - 5) The iTM BACnet Server Gateway Option shall be capable of being configured as a foreign device. It shall be capable of communicating across BACnet Broadcast Management Devices (BBMD) in different subnet networks.
 - 6) The iTM BACnet Server Gateway Option shall be run in environments with BACnet communication traffic up to 100 packets/second.

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- 7) The iTM BACnet Server Gateway Option functions shall be configurable through CSV file which shall be downloaded from iTM and configured by trained personnel.
- d. System Capacity
- 1) Max of 128 indoor units groups (Up to 256 indoor units) can be controlled from (BMS).
 - 2) Max of 8 DIII-Net ports shall be connected to iTM.
- e. The Building Management System shall monitor and control the following BACnet objects for indoor units:
- 1) Indoor unit ON/OFF status.
 - 2) Alarm status with error description.
 - 3) Room temperature.
 - 4) Indoor Unit ON details.
 - a) Off.
 - b) Normal [ON].
 - c) Override.
 - d) Setback.
 - 5) Filter sign status.
 - 6) Fan status.
 - 7) Communication status.
 - 8) Thermo-on status.
 - 9) Compressor status.
 - a) On.
 - b) Off.
 - c) Defrost.
 - 10) Aux heater status.
 - 11) Occupancy Mode.
 - a) Unoccupied.
 - b) Occupied.
 - c) Standby.
 - 12) Operation Mode (Cool, Heat, Fan, and Dry).
 - 13) Cooling and Heating set points during occupied mode.
 - 14) Cooling and Heating set points during unoccupied mode.
 - 15) Maximum and minimum cooling set point.
 - 16) Maximum and Minimum heating set point.
 - 17) Minimum cooling and heating set point differential.
 - 18) Fan Speed

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- a) Up to 3 speeds (dependent upon indoor unit type).
- 19) Vane Direction (dependent upon indoor unit type).
 - a) 5 fixed positions or swing position.
- 20) Remote controller permit/prohibit:
 - a) On/Off.
 - b) Mode.
 - c) Set Point.
- 21) Filter sign reset for indoor units.
- 22) Forced indoor units Off.
- f. The Building Management System may choose to monitor and control the following BACnet objects linked to iTM control logic:
 - 1) Enable/Disable iTM schedule operation.
 - 2) Set Timed Override Minutes.
 - a) Monitor and configure timer extension on iTM (30, 60, 90, 120, 150, 180 minutes).
 - 3) System forced Off.
 - a) Enable/Disable all emergency stop programs that are registered on the iTM.
 - 4) Schedule: The BMS shall utilize iTM schedule function or support weekly schedule settings through its programming.
 - a) BMS schedule shall support the indoor unit.
 - (1) Each scheduled event shall specify time and target group address.
 - (2) Each scheduled event shall include Occupancy Mode, Operation Mode, Occupied Cooling Set Point, Occupied Heating Set Point, and Unoccupied cooling set point, Unoccupied heating set point, Remote Controller On/Off Permit/Prohibit, Remote Controller Mode Permit/Prohibit, Remote Controller Set Point Permit/Prohibit, and Timed Override Enable.
 - (3) An override shall be provided for use enabling indoor unit operation during the unoccupied period by the BMS programming.

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- 5) Auto Changeover: The BMS shall utilize iTM Auto changeover function or support auto-changeover through its programming.
 - a) Auto-change shall provide changeover for both Heat Pump and Heat Recovery systems based upon the group configurations. This will allow the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat in accordance with the room temperature and set point temperature.
 - b) Changeover shall change the operation mode of the indoor unit that is set as the Changeover Master. The Changeover Master indoor unit shall then change the operation mode of all indoor unit groups daisy chained on the same DIII-Net communication bus to the same outdoor unit in the Heat Pump system or the same branch selector box in the Heat Recovery system.
 - c) Changeover to cooling mode shall occur when the room temperature is great than or equal to the cooling set point.
 - (1) Differential to be determined by BACnet building management system programming.
 - d) Changeover to heating mode shall occur when room temperature is less than or equal to the heating set point.
 - (1) Differential to be determined by BACnet building management system programming.
- 6) Guard Timer
 - a) Upon changeover, guard timer will prevent another changeover during this period.
 - b) Guard timer should be ignored by a change of set point manually from the BMS, Intelligent Touch Controller, Remote Controller, or by schedule.
 - c) Guard timer to be configured by BMS programming (30-minute minimum recommended).
- 7) Set Point Limitation
 - a) The BMS shall utilize maximum and minimum cooling and heating set point to configure upper and lower set points range.
- 8) System Shutdown
 - a) BMS should utilize System forced off point to execute emergency stop program registered on the iTM.

9) Restricted Functions

a) The following iTM functions shall be prohibited when the BACnet Server Gateway option enabled:

- (1) Interlocking Control.
- (2) Emergency Stop (emergency stop manual release).
- (3) Power Proportional Distribution (PPD) option.
- (4) BACnet Client option.
- (5) D-Net Service.
- (6) External Management Point Registration.

E. iTM Plus Adapter (DCM601A72)

1. The iTM Plus Adapter shall provide control for all VRV, SkyAir indoor units, and Daikin RA and FTXS indoor units with the use of the KRP928BB2S RA Adapter. It shall be capable of handling a maximum of 64 indoor unit groups and 128 indoor units connected a maximum of 10 outdoor units. The iTM Plus Adapter is to be used in conjunction with intelligent Touch Manager. Up to 7 iTM Plus Adapters can be connected to a single intelligent Touch Manager. This combination will provide intelligent Touch Manager monitoring and control of up to 512 indoor unit groups, 1024 indoor units, and 80 outdoor units. The iTM Plus Adapter shall support operations superseding that of the local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.
2. The controller wiring shall consist of a non-polar two-wire connection to the outdoor unit at terminals F1F2 (out-out). The iTM Plus Adapter is wall mounted and is used in conjunction with the intelligent Touch Manager to maintain the optimal operation of the connected indoor unit(s). The iTM Plus Adapter is connected to the intelligent Touch Manager via a polarity sensitive 18-2 AWG stranded non-shielded wire (field-supplied).
3. The iTM Plus Adapter can be used in conjunction with the BRC1E73 (Navigation Remote Controller), the BRC2A71 (Simplified Remote Controller), or the BRC4C82/7E83/7C812/7E818 (Wireless Remote Controller), BACnet interface, Lonworks interface and Modbus Adapter to control the same indoor unit groups. No more than 2 remote controllers can be placed in the same group. The remote controller shall require daisy chain wiring for grouping multiple indoor units (up to 16) together. Manual addressing is required of each indoor unit group associated with the iTM Plus Adapter.
4. Mounting
 - a. The iTM Plus Adapter can be mounted on the wall or in a standard enclosure (field-supplied).
5. Features
 - a. The iTM Plus Adapter shall be approximately 6.30" x 5.87" x 2.41" in size.
6. Basic Operation

- a. Control of all associated indoor unit groups shall be done via the connected intelligent Touch Manager.
7. Programmability
 - a. Programming of all associated indoor unit groups shall be done via the connected intelligent Touch Manager (iTM).

2.12 CENTRALIZED CONTROLLER AND NETWORK WIRING

A. General: Network

The VRV Controls shall be made up of local remote controllers, a centralized controller, and open protocol network devices that transmit information via the communication bus. The VRV Controls Network shall have the ability to be accessed via a networked PC. The VRV Controls Network shall support operation monitoring, scheduling, error e-mail distribution, general user software, tenant billing, maintenance support, and integration with Building Management Systems (BMS) using open protocol via BACnet®.

B. Electrical Characteristics

1. General: The controller will require 24 VAC to power the controller. The multi-zone controller shall supply 16 volts DC to the communication bus. The voltage may rise or fall in relation to the transmission packets that are sent and received. The Centralized Controller shall provide control for all units and a maximum of 64 indoor unit groups and 128 indoor units connected to a maximum of 10 outdoor units. The centralized Controller shall support operations superseding that of the local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.
2. Wiring: The centralized controller communication wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to branch selector, then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit. The termination of the wiring shall be non-polar. The remote-control wiring shall run from the indoor unit control terminal block to the remote controller connected with the indoor unit. The Centralized Controller shall be equipped with one RJ-45 Ethernet port to support interconnection with a network PC via the internet or Local Area Network (LAN).
3. Wiring size: Wiring shall be non-shielded, 2-conductor sheathed vinyl cord or cable, and 18 AWG stranded copper wire.

C. Display Features:

1. The Intelligent Touch Controller shall be approximately 9.07" x 5.79" in size with a backlit 5.7" LCD display.
2. Display information shall be selectable from English, French, Italian, German, or Spanish.

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3. Featured backlit LCD with contrast adjustment and auto off after 30 minutes (default) is adjustable between 1 to 60 minutes.
4. The Controller shall display On/Off, Operation Mode, Set Point, Space Temperature, Louver Position, Fan Speed for Group/Zone.
5. The Controller shall display Date (MM/DD/YYYY) or DD/MM/YYYY format (selectable) and day of the week along with the time of day (12-hr or 24-hr display selectable).
6. The Controller shall adjust for Daylight Savings Time (DST) automatically.
7. Display information shall be updated every 3 seconds to show the latest status of the indoor unit groups.
8. System status icons shall display On/Off (color coded), Malfunction/Error (color coded), Forced Stop, Set Schedule, Setback/Auto-changeover, Filter, and Screen Lock.
9. The controller shall display the temperature set point in one-degree increments with a range of 60°F - 90°F (16°C - 32°C).
 - a. Display of temperature set point information shall be configurable for Fahrenheit or Celsius.
10. Display shall reflect room temperature 0°F - 176°F (-18°C - 80°C) range in one-degree increment.
 - a. Display of room temperature information shall be configurable for Fahrenheit or Celsius.
11. The System Setting Mode shall be used to configure options and display information for each Zone or Group.
12. Zone configuration shall display Set Point Range Limitation, Setback Temperature setting, and Auto-changeover for each Zone.
13. Indoor units shall be capable of being displayed by Zone or Group.
 - a. Zones configuration via the Centralized Controller shall consist of a single indoor unit group or a collection of indoor unit groups blocked together for control and monitoring purposes.
 - b. Groups shall consist of 1 to 16 indoor unit daisy chained together via the remote-control wiring on PIPw of the indoor unit terminal block for control and monitoring purposes.
 - c. Groups and Zones may be assigned names (ex., Office 101, Lobby, North Hallway, etc.).
14. Error status shall be displayed in the event of system abnormality/error with one of two color coded icons placed over the indoor unit icon.
 - a. Communication errors between the Intelligent Touch Controller and the indoor units shall be displayed with a blue triangle placed over the indoor unit icon.
 - b. System errors between the Intelligent Touch Controller and the indoor units shall be displayed with a yellow triangle placed over the indoor unit icon.
 - c. Error history shall be available for viewing the 10 most recent errors/abnormalities.

D. Basic Operation:

1. Capable of controlling Zone(s) or Group(s) of up to 64 indoor unit groups (128 indoor units).
2. Controller shall control the following group operations:
 - a. On/Off
 - b. Operation Mode (Cool, heat, Fan, Dry, and Auto).
 - c. Independent Cooling and Heating Set Points in the occupied mode.
 - 1) Cooling set point shall be maintained higher than or equal to the heating set point.
 - 2) Adjustable minimum set point differential 0 - 7° (0 - 4°C) between cooling and heating set points.
 - 3) Selectable single set point mode.
 - d. Independent Setup (Cooling) and Setback (Heating) set points in the unoccupied mode adjustable to 40 - 95°F (5 - 35°C).
 - 1) Setup and Setback set points shall be set outside of the opposite set range.
 - 2) The recovery differential shall be 4°F (default) and adjustable between 2 - 10°F.
 - 3) Settings shall be applied based upon the Zone configurations.
 - e. Fan Speed:
 - 1) Up to 3 speeds (dependent upon indoor unit type).
 - f. Airflow direction (dependent upon indoor unit type).
 - 1) 5 fixed positions or swing position.
 - g. The controller shall be able to limit the user adjustable set point ranges individually for cooling and heating based upon the Zone configurations.
 - h. Remote controlled permit/prohibit of On/Off, Mode, and Set Point.
 - i. Lock out setting for Intelligent Touch Controller display.
 - j. Indoor unit Group/Zone assignment.
3. Capable of providing battery backup power for up to 2 years in total time for the clock.
 - a. Settings stored in non-volatile memory.

E. Programmability:

1. Controller shall support weekly schedule settings.
 - a. Selectable weekly patterns:

- 1) 7-day.
 - 2) Weekday + Weekend.
 - 3) Weekday + Saturday + Sunday.
- b. The schedule shall support unit On/Off.
- c. 8 independent schedules configurable with up to 8 events settable for each schedule.
- 1) Each scheduled event shall specify time and target Zone or Group.
 - 2) Each scheduled event shall include On/Off, Operation Mode, occupied Cooling Set Point, Occupied Heating Set Point, Setup (Cooling) Set Point, Setback (Heating) Set Point, Remote Controller On/Off Prohibit, Remote Controller Mode Prohibit, Remote Controller Set Point Prohibit, and Timed Override Enable.
 - 3) Independently settable Cooling and Heating Set Points when unit is On (occupied).
 - 4) Setup (Cooling) and Setback (Heating) Set Points when unit is Off (unoccupied) by Zone.
 - 5) Time setting in minute increments.
 - 6) A 2 hour override shall be provided for use enabling indoor unit operation during the unoccupied period.
- d. A maximum of 40 exception days can be scheduled on the yearly schedule.
- 1) Exception days shall be used to override specified days on the weekly schedule based upon irregular occupied/unoccupied conditions.
 - 2) Exception days can be configured on a set date (Jan 1) or floating date (1st Monday in September).
2. The Controller shall support auto-changeover.
- a. Auto-change shall provide Individual, Fixed, and Averaging changeover methods for both Heat Pump and Heat Recovery systems based upon the Zone configurations. This will allow for the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat in accordance with the room temperature and set point temperature.
 - b. Individual method (recommended for Heat Recovery System).
 - c. Changeover evaluated by room temperature and set points of the individual indoor unit group in the Zone.
 - d. Changeover affects individual indoor unit group in the Zone.
3. Fixed Method:
- a. Changeover evaluated by room temperature and set points of the representative unit (first registered unit) in the Zone.
 - b. Changeover affects all indoor unit groups in the Zone.

4. Average Method:
 - a. Changeover evaluated by the average of all indoor unit group's room temperatures and set points in the Zone.
 - b. Changeover affects all indoor unit groups in the Zone.
5. Changeover shall change the operation mode of the indoor unit that is set as the Changeover Master. The Changeover Master indoor unit shall then change the operation mode of all indoor unit groups daisy chained to the same outdoor unit in the Heat Pump system or branch selector box in the Heat recovery system.
6. Changeover to cooling mode shall occur when the room temperature is greater than or equal to the average of the cooling and heating set points +2.7°F.
7. Changeover to heating mode shall occur when room temperature is less than or equal to the average of the cooling and heating set points +2.7°F.
8. 1-hour guard timer
 - a. Upon changeover, guard time will prevent another changeover during this period.
 - b. Guard time is ignored by a change of set point manually from either Centralized Controller or Remote Controller or by schedule.
 - c. 60 minutes as default, configurable to 15, 30, or 90 minutes.

F. Controller Shall support Interlock

1. Interlock feature for use with 3rd party equipment (DOAS, dampers, occupancy sensing, etc.) to automatically control groups or zones corresponding to the change of the operation states or the On/Off states of any group.
2. Requires Digital Input/output (DEC102A51-US2) unit or Digital Input (DEC101A51-US2) unit.
 - a. On/Off based monitoring and control of equipment.
 - b. Manual or scheduled operation of equipment.
 - c. Operation based upon interlock with VRV indoor unit group(s).
 - d. Monitor equipment error/alarm status.
3. Controller shall support force shutdown of associated indoor unit groups.

2.13 ADVANCED MULTI-ZONE CONTROLLER AND NETWORK WIRING

A. General: Network

The VRV Controls shall be made up of local remote controllers, a centralized controller, and open protocol network devices that transmit information via the communication bus. The VRV Controls Network shall have the ability to be accessed via a networked PC. The VRV Controls Network shall support operation monitoring, scheduling, error e-mail distribution, general user software, tenant billing, maintenance support, and integration with Building Management Systems (BMS) using open protocol via BACnet®.

B. DCS601C71: Intelligent Touch Controller (ITC)

1. The Intelligent Touch Controller (Version 6.02) shall provide control for all VRV, SkyAir, and Daikin RA and FTXS indoor units with the use of the KRP928BB2S RA Adapter. It shall be capable of controlling a maximum of 64 indoor unit groups and 128 indoor units connected to a maximum of 10 outdoor units. The Intelligent Touch Controller shall support operations superseding that of the local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.
2. The controller wiring shall consist of a non-polar two-wire connection to the indoor unit at terminals F1F2 (out-out) of the outdoor unit. The Intelligent Touch Controller is wall mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s).
3. The Intelligent Touch Controller can be used in conjunction with the BRC1E71 (Navigation Remote Controller), the BRC2A71 (Simplified Remote Controller), or the BRC4C82/7E83/7C812/7E818 (Wireless Remote Controller), BACnet, and Lon works interfaces to control the same indoor units (up to 16) together. Manual addressing is required of each indoor unit group associated with the Intelligent Touch Controller.
4. The Intelligent Touch Controller shall be equipped with an RJ-45 Ethernet port to support interconnection with a network PC via the internet or Local Area Network (LAN).
5. Optional software functions shall be available so that facility staff can securely log into each Intelligent Touch Controller via the PC's web browser to support monitoring, scheduling, error email, and general user functions. Additional optional software functions of Tenant billing, and HTTP Interface shall also be available. The optional software shall require advanced purchase and can only be activated upon receipt of a license key from Daikin AC.
6. Mounting: The Intelligent Touch Controller shall be mounted on the wall or into a recessed fixing box (KJB411A).

C. Electrical Characteristics

1. General: The controller will require 24 VAC to power the controller. The multi-zone controller shall supply 16 volts DC to the communication bus. The voltage may rise or fall in relation to the transmission packets that are sent and received. The Centralized Controller shall provide control for all units and a maximum of 64 indoor unit groups and 128 indoor units connected to a maximum of 10 outdoor units. The centralized Controller shall support operations superseding that of the local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.
2. Wiring: The centralized controller communication wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to branch selector, then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit. The termination of the wiring shall be non-polar. The remote-control wiring shall run from the indoor unit control terminal block to the remote controller connected with that indoor unit. The Centralized Controller shall be equipped with an RJ-45 Ethernet port to

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support interconnection with a network PC via the internet or Local Area Network (LAN).

3. Wiring size: Wiring shall be non-shielded, 2-conductor sheathed vinyl cord or cable, and 18 AWG stranded copper wire.

D. Display Features:

1. The Intelligent Touch Controller shall be approximately 9.07" x 5.79" in size with a backlit 5.7" LCD display.
2. Display information shall be selectable from English, French, Italian, German, or Spanish.
3. Featured backlit LCD with contrast adjustment and auto off after 30 minutes (default) is adjustable between 1 to 60 minutes.
4. The Controller shall display On/Off, Operation Mode, Set Point, Space Temperature, Louver Position, Fan Speed for Group/Zone.
5. The Controller shall display Date (MM/DD/YYYY) or DD/MM/YYYY format (selectable) and day of the week along with the time of day (12hr or 24hr display selectable).
6. The Controller shall adjust for Daylight Savings Time (DST) automatically.
7. Display information shall be updated every 3 seconds to show the latest status of the indoor unit groups.
8. System status icons shall display On/Off (color coded), Malfunction/Error (color coded), Forced Stop, Set Schedule, Setback/Auto-changeover, Filter, and Screen Lock.
9. The controller shall display the temperature set point in one-degree increments with a range of 60°F - 90°F (16°C - 32°C).
 - a. Display of temperature set point information shall be configurable for Fahrenheit or Celsius.
10. Display shall reflect room temperature 0°F - 176°F (-18°C - 80°C) range in one-degree increment.
 - a. Display of room temperature information shall be configurable for Fahrenheit or Celsius.
11. The System Setting Mode shall be used to configure options and display information for each Zone or Group.
12. Zone configuration shall display Set Point Range Limitation, Setback Temperature setting, and Auto-changeover for each Zone.
13. Indoor units shall be capable of being displayed by Zone or Group.
 - a. Zones configuration via the Centralized Controller shall consist of a single indoor unit group or a collection of indoor unit groups blocked together for control and monitoring purposes.
 - b. Groups shall consist of 1 to 16 indoor unit daisy chained together via the remote-control wiring on PIPw of the indoor unit terminal block for control and monitoring purposes.

- c. Groups and Zones may be assigned names (ex., Office 101, Lobby, North Hallway, etc.).
14. Error status shall be displayed in the event of system abnormality/error with one of two color coded icons placed over the indoor unit icon.
- a. Communication errors between the Intelligent Touch Controller and the indoor units shall be displayed with a blue triangle placed over the indoor unit Icon.
 - b. System errors between the Intelligent Touch Controller and the indoor units shall be displayed with a yellow triangle placed over the indoor unit icon.
 - c. Error history shall be available for viewing the 10 most recent errors/abnormalities.

E. Basic Operation:

- 1. Capable of controlling Zone(s) or Group(s) of up to 64 indoor unit groups (128 indoor units).
- 2. Controller shall control the following group operations:
 - a. On/Off.
 - b. Operation Mode (Cool, heat, Fan, Dry, and Auto).
 - c. Independent Cooling and Heating Set Points in the occupied mode.
 - 1) Cooling set point shall be maintained higher than or equal to the heating set point.
 - 2) Adjustable minimum set point differential 0 - 7° (0 - 4°C) between cooling and heating set points.
 - 3) Selectable single set point mode.
 - d. Independent Setup (Cooling) and Setback (Heating) set points in the unoccupied mode adjustable to 40 - 95°F (5 - 35°C).
 - 1) Setup and Setback set points shall be set outside of the opposite set range.
 - 2) The recovery differential shall be 4°F (default) and adjustable between 2 - 10°F.
 - 3) Settings shall be applied based upon the Zone configurations.
 - e. Fan Speed:
 - 1) Up to 3 speeds (dependent upon indoor unit type).
 - f. Airflow direction (dependent upon indoor unit type).
 - 1) 5 fixed positions or swing position.
 - g. The controller shall be able to limit the user adjustable set point ranges individually for cooling and heating based upon the Zone configurations.
 - h. Remote controlled permit/prohibit of On/Off, Mode, and Set Point.
 - i. Lock out setting for Intelligent Touch Controller display.

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- j. Indoor unit Group/Zone assignment.
- 3. Capable of providing battery backup power for up to 2 years in total time for the clock.
 - a. Settings stored in non-volatile memory.

F. Programmability:

- 1. Controller shall support weekly schedule settings.
 - a. Selectable weekly patterns:
 - 1) 7-day.
 - 2) Weekday + Weekend.
 - 3) Weekday + Saturday + Sunday.
 - b. The schedule shall support unit On/Off.
 - c. 8 independent schedules configurable with up to 8 events settable for each schedule.
 - 1) Each scheduled event shall specify time and target Zone or Group.
 - 2) Each scheduled event shall include On/Off, Operation Mode, occupied Cooling Set Point, Occupied Heating Set Point, Setup (Cooling) Set Point, Setback (Heating) Set Point, Remote Controller On/Off Prohibit, Remote Controller Mode Prohibit, Remote Controller Set Point Prohibit, and Timed Override Enable.
 - 3) Independently settable Cooling and Heating Set Points when unit is On (occupied).
 - 4) Setup (Cooling) and Setback (Heating) Set Points when unit is Off (unoccupied) by Zone.
 - 5) Time setting in minute increments.
 - 6) A 2-hour override shall be provided for use enabling indoor unit operation during the unoccupied period.
 - d. A maximum of 40 exception days can be scheduled on the yearly schedule.
 - 1) Exception days shall be used to override specified days on the weekly schedule based upon irregular occupied/unoccupied conditions.
 - 2) Exception days can be configured on a set date (Jan 1) or floating date (1st Monday in September).
- 2. The Controller shall support auto-changeover.
 - a. Auto-change shall provide Individual, Fixed, and Averaging changeover methods for both Heat Pump and Heat Recovery systems based upon the Zone configurations. This will allow for the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat in accordance with the room temperature and set point temperature.

- b. Individual method (recommended for Heat Recovery System).
 - c. Changeover evaluated by room temperature and set points of the individual indoor unit group in the Zone.
 - d. Changeover affects individual indoor unit group in the Zone.
 3. Fixed Method
 - a. Changeover evaluated by room temperature and set points of the representative unit (first registered unit) in the Zone.
 - b. Changeover affects all indoor unit groups in the Zone.
 4. Average Method
 - a. Changeover evaluated by the average of all indoor unit group's room temperatures and set points in the Zone.
 - b. Changeover affects all indoor unit groups in the Zone.
 5. Changeover shall change the operation mode of the indoor unit that is set as the Changeover Master. The Changeover Master indoor unit shall then change the operation mode of all indoor unit groups daisy chained to the same outdoor unit in the Heat Pump system or branch selector box in the Heat recovery system.
 6. Changeover to cooling mode shall occur when the room temperature is greater than or equal to the average of the cooling and heating set points +2.7°F.
 7. Changeover to heating mode shall occur when room temperature is less than or equal to the average of the cooling and heating set points +2.7°F.
 8. 1-hour guard timer
 - a. Upon changeover, guard time will prevent another changeover during this period.
 - b. Guard time is ignored by a change of set point manually from either Centralized Controller or Remote Controller or by schedule.
 - c. 60 minutes as default, configurable to 15, 30, or 90 minutes.
- G. Software Options: Licensed per option, per Intelligent Touch Controller shall be required. All PCs shall be field supplied.
 1. DCS004A71: Web/Email software.

Each Intelligent touch controller shall be capable of monitoring, operating, and scheduling a maximum of 64 indoor unit groups (128 indoor unit groups with the addition of the DIII-Net Plus Adapter) from a networked PC's web browser. It shall also be capable of creating general user access and sending detailed error emails to a customized distribution list (up to 3 email addresses).
 2. DCS002A71: Power Proportional Distribution (PPD)

The tenant billing option shall be capable of calculating VRV Controls Network equipment energy usage in kWh based on the energy consumption of the outdoor unit(s) divided among the associated indoor units. This software is used in conjunction with the

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Intelligent touch Controller and a Watt Hour Meter (WHM). A maximum of 3-Watt Hour Meters can be connected to the Intelligent Touch Controller. The use of the DIII-Net Plus Adapter will add an additional 3-Watt hour Meters.

The Power Proportional distribution results data can be saved to a PCMCIA card, or on a PC with the use of the web option software.

Data is saved in the CSV format. Results can be stored up to 12 months.

3. DCS007A51: HTTP Interface

This option shall be capable of creating a software interface between the VRV Controls Network and Home Automation controls systems.

H. DIII-Net Plus Adapter

1. The DIII-Net Plus Adapter shall provide control for all VRV, SkyAir indoor units, and Daikin RA and FTXS indoor units with the use of the KRP928BB2S RA Adapter. It shall be capable of handling a maximum of 64 indoor unit groups and 128 indoor units connected to a maximum of 10 outdoor units. The DIII-Net Plus Adapter is to be used in conjunction with Intelligent Touch Controller. This combination will provide Intelligent Touch controller monitoring and Control of up to 128 indoor unit groups, 256 indoor units, and 20 outdoor units. The DIII-net Plus Adapter shall support operations superseding that of the local remote controller, system configuration, daily/weekly scheduling, monitoring of operations status, and malfunction monitoring.
2. The controller wiring shall consist of a non-polar two-wire connection to the indoor unit at terminals F1F2 (out-out) of the outdoor unit. The DIII-Net Plus Adapter is wall mounted and is used in conjunction with the Intelligent Touch Controller to maintain the optimal operation of the connected indoor unit(s). The DIII-Net Plus Adapter is connected to the Intelligent Touch Controller via a RS-232-C/RJ-45 cable (supplied with adapter).
3. The DIII-Net Plus Adapter can be used in conjunction with the BRC1E71 (Navigation Remote Controller), the BRC2A71 (Simplified remote Controller), BACnet, and Lonworks interfaces to control the same indoor unit groups. No more than 2 remote controllers can be placed in the same group. The remote controller shall require daisy chain wiring for grouping multiple indoor units (up to 16) together. Manual addressing is required of each indoor unit group associated with the DIII-Net Plus Adapter.
4. Mounting:
The DIII-Net Plus Adapter can be mounted on the wall or in a standard enclosure (field supplied).
5. Features:
The DIII-Net Plus Adapter shall be approximately 7.47" x 6.19" in size.
6. Basic Operation:
Control of all associated indoor unit groups shall be done via the connected Intelligent Touch Controller.

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7. Programmability:

Programming of all associated indoor unit groups shall be done via the connected Intelligent Touch Controller.

I. Controller Shall support Interlock

1. Interlock feature for use with 3rd party equipment (DOAS, dampers, occupancy sensing, etc.) to automatically control groups or zones corresponding to the change of the operation states or the On/Off states of any group.
2. Requires Digital Input/output (DEC102A51-US2) unit or Digital Input (DEC101A51-US2) unit.
 - a. On/Off based monitoring and control of equipment.
 - b. Manual or scheduled operation of equipment.
 - c. Operation based upon interlock with VRV indoor unit group(s).
 - d. Monitor equipment error/alarm status.
3. Controller shall support force shutdown of associated indoor unit groups.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install unit's level and plumb.
- B. Install horizontal evaporator-fan components using manufacturer's standard mounting devices fastened to building structure, with vibration isolation as specified in Division 23 "Vibration Isolation". Install auxiliary drain pan under unit.
- C. Install vertical fan coil units on angle iron stand with vibration isolation as specified in Division 23 "Vibration Isolation". Install 4" high auxiliary drain pan under stand.
- D. Install ground-mounted, compressor-condenser components on 4-inch- (100-mm-) thick, reinforced concrete base that is 4 inches (100 mm) larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- E. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- F. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- G. Install seismic restraints.

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- H. Install compressor-condenser components on restrained, spring isolators with a static deflection as specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- I. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- J. Pipe all air handlers and drain pans to indirect waste. Provide condensate pumps where it is not possible to pipe drains by gravity.
- K. Provide leak detectors in auxiliary drain pans wired to stop unit and alarm BMS, or local alarm if there is no BMS.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Water Coil Connections: Comply with requirements specified in Division 23 Section "Hydronic Piping." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
 - 2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Division 23 Section "Hydronic Piping." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
 - 3. Remote, Direct Expansion Refrigerant Connectors: Comply with requirements specified in Division 23 Section "Refrigerant Piping".
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Division 23 Section "Ductwork" Drawings indicate the general arrangement of ducts. Connect supply **[and return]** ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

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C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Startup to be witnessed by owner designated representative.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126.1

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SECTION 238219

FAN COIL UNITS, CABINET HEATERS AND UNIT HEATERS

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.
- B. Vibration, Isolation, Seismic, Wind, and Flood Load Restraints for HVAC, Electrical, Plumbing and Fire Protection Components for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.

1.2 SUMMARY

- A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

- A. BMS: Building Management System.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension components.
 - 2. Structural members to which fan-coil units will be attached.
 - 3. Method of attaching hangers to building structure.

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4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 6. Perimeter moldings for exposed or partially exposed cabinets.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of fan-coil unit indicated.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.
- H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

- A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of wall sleeves for outdoor-air intake.

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1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Motor failure.
 - b. Coil, valve or fitting leak.
 - c. Casing failure.
 - d. Control component failure.
 - 2. Warranty Period: One (1) year from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan-Coil-Unit Filters: Provide one set of filters for construction and initial start-up, one set of filters for balancing, commissioning and air purging, and one set of filters for installation prior to final turnover of the units to the owner and one set of spare filters for delivery to Owner.
 - 2. Motors: Furnish four spare motors for each size installed.
 - 3. Control Valves: Ten spare valves and actuators for each size supplied.
 - 4. Control Transformers: Ten spare for each size.
 - 5. Relays: Ten spare for each size.
 - 6. Flow Control Valves: Ten spare for each size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. In the Fan-Coil-Unit Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Basis-of-Design Product: The design for each fan-coil unit is based on the product scheduled on plans. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

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2.2 UNIT/CABINET HEATERS

- A. Basis-of-Design Product: Units to be as scheduled or a comparable product by one of the following:
- B. Available Manufacturers:
 - 1. Trane.
 - 2. Williams Fan Coil.
- C. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- D. Coil Section Insulation: 1-inch (25-mm) thick glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.
- F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
- G. Filters: Minimum arrestance according to ASHRAE 52.1, and a Minimum Efficiency Reporting Value (MERV) according to ASHRAE 52.2.
 - 1. Pleated Cotton-Polyester Media: 90 percent arrestance and 8 MERV.
- H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.
- I. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
- J. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
 - 1. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

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- K. Control devices and operational sequence are specified in Division 23 Section "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
- L. Electrical Connection: Factory wire motors and controls for a single electrical connection terminating in a factory mounted disconnect switch.
- M. Capacities and Characteristics as scheduled on plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fan-coil units level and plumb.
- B. Install fan-coil units to comply with NFPA 90A.
- C. Suspend horizontal fan-coil units from structure with elastomeric hangers provide supplemental dunnage and supports as detailed. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

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1. Install piping adjacent to machine to allow service and maintenance.
2. Install piping package shipped loose by fan coil manufacturer.
3. Connect condensate drain to indirect waste.
 - a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

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3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

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SECTION 238233

RADIATORS AND CONVECTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Electric baseboard radiators.
 - 2. Hydronic and steam finned-tube radiators.
 - 3. Flat-pipe steel radiators.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Details of custom-fabricated enclosures indicating dimensions.
 - 3. Location and size of each field connection.
 - 4. Location and arrangement of piping valves and specialties.
 - 5. Location and arrangement of integral controls.
 - 6. Enclosure joints, corner pieces, access doors, and other accessories.
 - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

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1. Structural members, including wall construction, to which convection units will be attached.
 2. Method of attaching convection units to building structure.
 3. Penetrations of fire-rated wall and floor assemblies.
- D. Color Samples for Initial Selection: For units with factory-applied color finishes.
- E. Color Samples for Verification: For each type of exposed finish required.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For convection heating units to include in emergency, operation, and maintenance manuals.
- 1.4 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 ELECTRIC BASEBOARD RADIATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Berko Electric Heating; a division of Marley Engineered Products.
 2. Chromalox; a division of Emerson Electric Company.
 3. Indeeco.
 4. Markel Products; a division of Marley Engineered Products.
 5. Qmark Electric Heating; a division of Marley Engineered Products.
- D. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.

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- E. Heating Elements: Nickel-chromium-wire heating element enclosed in metallic sheath mechanically bonded to fins, with high-temperature cutout and sensor running the full length of the element. Element supports shall eliminate thermal expansion noise.
 - 1. Volts: As scheduled on drawings.
 - 2. Phase: As scheduled on drawings.
 - 3. Hertz: As scheduled on drawings.
 - 4. Heat Output: As scheduled on drawings.

- F. Rust-Resistant Enclosures: Minimum 18 gauge thick ASTM A 653/A 653M, G60 galvanized-steel, removable front cover.
 - 1. Full-height back.
 - 2. Full-length damper.
 - 3. End panel.
 - 4. Inside and outside corners.
 - 5. Joiner pieces to snap together.
 - 6. Enclosure Height: As scheduled on drawings.
 - 7. Enclosure Depth: As scheduled on drawings.
 - 8. Finish: Baked-enamel finish in manufacturer's custom color as selected by Architect.
 - 9. Element Brackets: Primed and painted steel to support front panel and element.

- G. Unit Controls: Integral line-voltage thermostat.

- H. Accessories:
 - 1. Filler sections without a heating element matching the adjacent enclosure.
 - 2. Straight-blade-type receptacles complying with DSCC W-C-596G/GEN, NEMA WD 1, NEMA WD 6, and UL 498; in color selected by Architect.

2.2 HOT-WATER FINNED-TUBE RADIATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Embassy Industries, Inc.
 - 2. Rittling, a div. of Hydro-Air Components.
 - 3. Slant/Fin.
 - 4. Vulcan.

- B. Performance Ratings: Rate finned-tube radiators according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

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- C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One tube end shall be belled.
1. Tube Diameter: As scheduled on plans.
 2. Fin Size: As scheduled on plans.
 3. Fin Spacing: As scheduled on plans.
 4. Number of Tiers: As scheduled on plans.
 5. Heat Output: As scheduled on plans.
 6. Entering Air Temperature: As scheduled on plans.
 7. Average Water Temperature: As scheduled on plans.
 8. Minimum Water Velocity: As scheduled on plans.
 9. Entering Steam Pressure: As scheduled on plans.
- D. Heating Elements: Steel tubing mechanically expanded into flanged collars of evenly spaced steel fins resting on element supports. Tube ends shall be threaded.
1. Tube Diameter: As scheduled on plans.
 2. Fin Size: As scheduled on plans.
 3. Fin Spacing: As scheduled on plans.
 4. Number of Tiers: As scheduled on plans.
 5. Heat Output: As scheduled on plans.
 6. Entering Air Temperature: As scheduled on plans.
 7. Average Water Temperature: As scheduled on plans.
 8. Minimum Water Velocity: As scheduled on plans.
 9. Entering Steam Pressure: As scheduled on plans.
- E. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.
- F. Front Panel: Minimum 0.0528-inch- thick steel.
- G. Rust-Resistant Front Panel: Minimum 0.052-inch- thick, ASTM A 653/A 653M, G60 galvanized steel.
- H. Wall-Mounting Back Panel: Minimum 0.0329-inch- thick steel, full height, with full-length channel support for front panel without exposed fasteners.
- I. Floor-Mounting Pedestals: Conceal insulated piping at maximum 36-inch spacing. Pedestal-mounting back panel shall be solid panel matching front panel. Provide stainless-steel escutcheon for floor openings at pedestals.
- J. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.
- K. Finish: Baked-enamel finish in manufacturer's standard or custom color as selected by Architect.

- L. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.
- M. Enclosure Style: Sloped or Flat top. As scheduled on plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive convection heating units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for hydronic-piping, steam-piping or electrical connections to verify actual locations before convection heating unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BASEBOARD RADIATOR INSTALLATION

- A. Install units level and plumb.
- B. Install baseboard radiators according to Guide 2000 - Residential Hydronic Heating.
- C. Install enclosure continuously around corners, using outside and inside corner fittings.
- D. Join sections with splice plates and filler pieces to provide continuous enclosure.
- E. Install access doors for access to valves.
- F. Install enclosure continuously from wall to wall.
- G. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.
- H. Install valves within reach of access door provided in enclosure.
- I. Install air-seal gasket between wall and recessing flanges or front cover of fully recessed unit.
- J. Install piping within pedestals for freestanding units.

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3.3 FINNED-TUBE RADIATOR INSTALLATION

- A. Install units level and plumb.
- B. Install finned-tube radiators according to Guide 2000 - Residential Hydronic Heating.
- C. Install enclosure continuously around corners, using outside and inside corner fittings.
- D. Join sections with splice plates and filler pieces to provide continuous enclosure.
- E. Install access doors for access to valves.
- F. Install enclosure continuously from wall to wall.
- G. Terminate enclosures with manufacturer's end caps, except where enclosures are indicated to extend to adjoining walls.
- H. Install valves within reach of access door provided in enclosure.
- I. Install air-seal gasket between wall and recessing flanges or front cover of fully recessed unit.
- J. Install piping within pedestals for freestanding units.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping Steam and Condensate Heating Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water units and components to piping according to Division 23 Section "Hydronic Piping."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Division 23 Section "Instrumentation and Control for HVAC."
- D. Install piping adjacent to convection heating units to allow service and maintenance.
- E. Ground electric convection heating units according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

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3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper convection heating unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace convection heating units that do not pass tests and inspections and retest as specified above.

END OF SECTION

SPECIFICATIONS GROUP

Facility Services Subgroup

DIVISION 26 - ELECTRICAL

Division	Section Title
260500	BASIC ELECTRICAL REQUIREMENTS
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
260544	SLEEVES FOR RACEWAYS AND CABLES
260548	VIBRATION ISOLATION, WIND & LOAD RESTRAINTS FOR HVAC, PLUMBING & ELECTRICAL COMPONENTS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
260573	OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
260801	ELECTRICAL TESTING
260923	LIGHTING CONTROL DEVICES
262200	LOW-VOLTAGE TRANSFORMERS
262413	SWITCHBOARDS
262416	PANELBOARDS
262726	WIRING DEVICES
262813	FUSES
262816	OVERCURRENT PROTECTION, SWITCHES, ENCLOSED SWITCHES AND CIRCUIT BREAKERS
263111	ADDRESSABLE FIRE ALARM SYSTEM

END OF TABLE OF CONTENTS

SECTION 260500 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes general administrative and procedural requirements for electrical installations.
- B. This Section is a part of each Division 26 Section.

1.2 DEFINITIONS AND INTERPRETATIONS

A. Technical Definitions:

- 1. Regardless of their usage in codes or other industry standards, certain words as used in the drawings or specifications for the electrical work shall be understood to have the specific meanings ascribed to them in the following list:

“Circuitry” - - Any electric work (not limited to light and power distribution) which consists of wires, cables, raceways and/or specialty wiring methods assemblies taken all together complete with associated junction boxes, pull boxes, outlet boxes, joints. Couplings, splices and connections except limited to a lesser meaning by specific description.

“Wiring” - - Same as Circuitry.

“Circuit” - - Any specific runs of circuitry.

“This Trade” - - The Sub-Contractor responsible for all work specified under this Section of the work.

“Branch Circuit” - - Any light and power distribution system which, at its load end, is directly connected to one or more electrical energy consuming items with no over current protection devices interposed, other than (where required) those protecting the energy consuming items from overloading or overheating.

“Appliance Panel” - - Any panel, used in light and power distribution system, containing only single pole and multi-pole branches rated in various sizes.

“Lighting Panel” - - Any panel, used in a light and power distribution system, having all (or the majority) of its branches single pole and rated the same.

“Lighting and Appliance Branch Circuitry” - - All or any portion of branch circuits outgoing from a lighting or appliance panel.

“Feeder” - - Any item of light and power circuitry used in a distribution system which is not lighting and appliance branch circuitry.

“Main Feeder” - - Any feeder which, at its supply end, is connected through its own over current protection (and switching) device and none other, directly to a main service or a main service over current protection (and switching) device.

“Branch Feeder” - - A feeder, other than a main feeder, which complies with definition of a branch circuit.

“Submain Feeder” - - A feeder which is neither a main feeder nor a branch feeder.

“Power Panel” - - Same as distribution panel, except with all (or the majority) of its branches used for feeders supplying other panels.

“Motor Power Circuit” - - Any circuit which operates nominally at 100 volts or more and which carries electrical input energy to a motor.

“Motor Control Circuit” - - (used in conjunction with a motor for which a magnetic starter is supplied) - - Any circuit containing an extension of power circuit wires, other than those constituting the direct connection between source or supply, started and motor.

“Motor Control Actuating Device” - - Any device which performs a switching function in a motor control circuit (pushbuttons, automatic contacting devices, etc.).

“Package Unit” - - An item of equipment having one or more motors or other electric energy consuming elements integrally factory mounted on a single base, complete with all associated control devices and interconnecting wiring.

“Low-Voltage” - - Below 50 volts.

“Process Control System” - - An overall control and/or logging system of a low voltage or pneumatic type available as a fully installed “package” from specialty manufacturers (commonly referred to as a “Temperature Control System” where used in conjunction with air conditioning).

“Grade Slab” - - A building floor slab which is in contact with or directly over grade (Earth).

“Building Confines” - - The extent of a building, as defined by the outside surfaces of its peripheral walls, the top surface or its roof and the underside surface of its grade slab.

“Distribution Switch” - - Any switch used in a light and power system other than a tumbler, toggle or specialty switch in the “wiring device” category.

“Normal Electric Work Conditions” - - Locations within building confines which are neither damp, wet nor hazardous and which are not used for air handling.

“Underground” - - Subsurface and exterior to building foundations.

“At Underside of Grade Slab” - - Under a grade slab and integrated into it.

“Standard” - - (as applied to wiring devices) - - Not of a separately designated individual type.

“Raceway” - - Any pipe, duct, extended enclosure or conduit (as specified for a particular system) which is used to contain wires and which is of such nature as to require that the wires be installed by a “pulling in” procedure.

“Concealed” - - (as applied to circuitry) - - Covered completely by building materials, except for penetrations (by boxes and fittings) to a level flush with the surface as necessitated by functional or specified accessibility requirements.

“Primary” - - (as applied to light and power distribution) - - Over 600 volts.

“Secondary” - - (as applied to light and power distribution) - - Under 600 volts.

“Assembly” - - A defined set of elements of electric work.

“B.M.S.” - - Building Management System.

B. General Definitions:

1. This section assumes that a Construction Manager is reporting directly to the Owner and is authorized to act on behalf of the Owner as called out. In any situation where a CM is not a part of the project, all responsibilities called to be by the CM will be performed by the General Contractor reporting directly to the Owner.

a. For purposes of these Specifications, the following definitions apply:

- 1) “Engineer” - the Engineer of record.
- 2) “Provide” - to “furnish” and “install”.
- 3) “Install” - to receive; handle; rig; set in place; join; unite; fasten; link; attach; set up or otherwise connect together; complete, tested and ready for normal satisfactory operation including all labor inclusive of start-up and commissioning.
- 4) “Furnish” - to supply all materials, equipment, testing apparatus, controls, tests, commissioning, accessories, warranty and all other items customarily required for the proper and complete application.

- 5) "As directed" - as directed by the Architect or the Engineer.
- 6) "Concealed" - embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings (including accessible ceilings)
- 7) "Exposed" - not concealed (visible without removal of wall or ceiling)
- 8) "Submit" - submit to the Architect and/or the Engineer for review.
- 9) "By Other Trades" or "Others" or "Oth"-----By persons or parties responsible for work at the project other than the party or parties who have been duly awarded the contract for the work of this trade. In the event that this document is used to acquire work as part of a general construction contract the words "by other trades" shall mean by persons or parties who are not anticipated to be the sub-contractor for this trade working together with the general contractor. In this context the words "by other trades" shall not be interpreted to mean not included in the overall contract.
- 10) Where reference is made to "N.E.M.A. Standards," it shall be understood that this reference is to the "approved Standards," published by the National Electrical Manufacturers Association, Main Office-155 East 44th Street, New York, NY 10017.
- 11) Where reference is made to "A.N.S.I. Standards", it shall be understood that this reference is to the standards published by the American National Standards Institute Incorporated.
- 12) Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- 13) It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.
- 14) No exclusions from, or limitations, in the language used in the drawings or specifications shall be interpreted as meaning that the appurtenances or accessories necessary to complete any required system or item of equipment are to be omitted.

- 15) The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Work shown on all drawings including floor plans, riser diagrams, schedules and details is the responsibility of the contractor regardless of conflicts and coordination. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance mechanical drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings.
- 16) No interpretations shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- 17) Certain details appear on the drawings, which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
- 18) Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
- 19) The use of words in the singular shall not be considered as limiting where other indications denote that more than one items is referred to.

C. Abbreviations:

1. For purposes of these Specifications the following abbreviations apply:

ADA	American Disabilities Act
AGA	American Gas Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BMCS	Building Management and Control System

BOCA	Building Officials and Code Administrators
EPA	Environmental Protection Agency
ETL	Electronic Testing Laboratory
FM	Factory Mutual
FS	Federal Specification (General Services Administration)
IEEE	Institute of Electrical and Electronic Engineers
IRI	Industrial Risk Insurers
LEED	Leadership in Energy and Environmental Design
MCAA	Mechanical Contractors Association of America
MSDS	Materials Safety Data Sheet
MSS	Manufacturer's Standardization Society Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code (NFPA 70)
NYSERDA	New York State Energy and Research Development Authority
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NUSIG	National Uniform Seismic Installation Guidelines
OSHA	Occupational Safety Health Administration
UL	Underwriter Laboratories
UPS	Uninterruptible Power System
USGBC	United States Green Building Council

1.3 RELATED DOCUMENTS

A. Submittals

Section 013300

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Basic Electrical Requirements
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- B. Construction Waste Management Section 017419
- C. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and other sections of Division 21.

1.4 QUALITY CONTROL

- A. Comply with current governing codes, ordinances and regulations, as well as with requirements of EPA, U.L. and all other applicable codes.
- B. Comply with the requirements of agencies or authorities having jurisdiction over any part of the work and secure all necessary permits.
- C. Where codes or standards are listed herein, the applicable portions apply.
- D. Plans, specifications, codes and standards are minimum requirements. Where requirements differ, apply the more stringent.
- E. Should any change in plans or specifications be required to comply with governing regulations, notify the Architect/Engineer at the time of submitting this bid.
- F. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workmanlike manner by competent workmen. Provide a competent, experienced full-time superintendent who is authorized to make decisions on behalf of the contractor.
- G. All equipment and material to be furnished and installed on this Project shall be UL, ETL or any other recognized agency listed, and be suitable for its intended use in this project in accordance with the requirements of the City, state or any other Authority having jurisdiction.

1.6 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

- A. American Society for Testing and Materials (ASTM).
- B. National Fire Protection Association (NFPA).
- C. National Electrical Manufacturers Association (NEMA).
- D. Institute of Electrical and Electronic Engineers (IEEE).
- E. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
- F. Environmental Protection Agency (EPA).
- G. National Electrical Code (NEC).
- H. Occupational Safety and Health Administration (OSHA).
- I. Underwriters Laboratories (UL).
- J. Electrical Testing Laboratories (ETL).
- K. BOCA National Building Code.
- L. Uniform Building Code.
- M. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- N. Building Code of New York State

1.7 PROPOSALS AND ALTERNATES

- A. See the Contractor's and/or Owner's "Instructions to Bidders" for Allowances, Unit Prices and Alternates.
- B. Compliance Reviews: The contractor and equipment vendor shall provide a Compliance Review with the bid proposal of the applicable Drawings, Specifications and Addenda and for all equipment and alternates listed hereinafter for this Project. The Compliance Review will be paragraph-by-paragraph review of the Specifications with the following information, "C", "D", "E" or "N/A", marked for each Specification section paragraph in the margin of the Specification and any subsequent Addenda.
 - 1. "C": Comply with no exceptions.

2. “D”: Comply with minor deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
3. “E”: Exception. Equipment, product or material does not comply. For each and every exception, provide a numbered footnote with reasons for the exception for the Owner’s consideration and possible alternatives.
4. “N/A”: The specification paragraph does not apply to the proposed equipment, material or product.
5. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the equipment proposed for this project is in complete compliance with the Contract Documents. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradictions do not release the Contractor from being in complete compliance, unless the exception or deviation has been specifically noted (explicitly, not by implication) in the Compliance Review.

C. Equipment Alternatives:

1. Request for Substitution - Contractor initiated change to specified equipment or system for which the Owner/Architect/Engineer reserve the right to reject without review. Requests for Substitution must comply with the following:
 - a. Submit proposals to supply substitute materials or equipment, in writing, to the Construction Manager. Include the following information with the proposal:
 - 1) A description of the difference between the contract document requirements and that proposed listing the comparative features of each, including operating cost impact and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of implementation costs.
 - 2) A list of the contract requirements that must be revised if the substitution is accepted, including any suggested specification revisions. Include a description and estimate of costs the Engineer of record may incur in implementing the proposed substitution.
 - 3) Include a description and estimate of costs the Owner may incur in implementing the change, such as test, evaluation, operating and support costs.
 - 4) A projection of any effects the proposed change would have on collateral costs to the Owner.
 - 5) A statement of any effect on the contract completion time or the delivery schedule.
 - 6) A statement indicating the reduction to the contract price if the Owner accepts the change. Be responsible for appropriate modifications to all trades.

2. Include all revisions required to adapt substitutions in such proposals, including revisions by other trades. Only substitutions that reflect equal quality with a lower contract price and/or decreased operating costs will be considered.
3. Wherever operating results such as quantity delivered or pressure obtained are scheduled, or when the make and size of apparatus, for which such quantities are readily determinable, is specified, the substitution being proposed must conform substantially to the quantities specified or implied. The substitution must fit into available space conditions and must function properly in coordination with the rest of the system.

1.8 DRAWINGS

- A. The Drawings show the general layout of the various items of equipment. However, layout of equipment, accessories, specialties, etc., are diagrammatic unless specifically dimensioned and do not necessarily indicate every required fitting, support or similar items required for a complete installation. Consult the Architectural Drawings and details for exact locations of fixtures and equipment. Where same is not definitively located, obtain the information from the Architect before proceeding. Any reasonable changes in locations indicated shall be made by the Contractor without additional cost to the Owner, if such changes are ordered prior to performance of the affected Work.
- B. The Contractor shall follow the Drawings in laying out the Work and check Drawings of all trades to verify spaces in which Work will be installed. Maintain maximum headroom and where space conditions appear inadequate; the Architect shall be notified before proceeding with the installation.
- C. Equipment shown on the Drawings has been coordinated for structural penetrations, electrical connection, operating and service (maintenance) requirements and physical size with regard to the space where the equipment is shown. If they comply with the Specifications, these and the other specified manufacturers of this equipment will be acceptable contingent on the Contractor providing a complete installation and maintaining full responsibility to provide, at no additional cost, any modifications to the Architectural, Structural, Mechanical or Electrical Systems that are required to properly install, operate and service the equipment being used. These modifications shall not include additional area for equipment unless approved by the Architect.
 1. The Contractor shall note these changes on the equipment submittals and the Compliance Review and shall show all differences in equipment being supplied from that specified and shown on the Drawings. Failure of the Contractor to provide this information with the submittal will indicate the submitted equipment meets or exceeds the requirements of the equipment shown on the Drawings in performance and is physically no larger in housing size.
 - a. Failure of the Contractor to comply with the above and any discrepancies found should result in the Contractor providing equipment equal to that specified at the Contractor's expense.

1.9 SUBMITTALS

- A. General: The following information is required for review by the Owner, Architect and Engineer and is to be provided as it applies to this contract. It does not address items that may be required by the Construction Manager such as daily reports, minutes to safety meetings, etc.:
1. Requisition Breakdown (Include material quantities relative to each area, i.e., length of pipe or pounds of sheet metal.)
 2. Unit Prices (prior to contract award)
 3. Wage Rate Breakdowns (prior to contract award)
 4. Projection of manpower loading
 5. Statement of review and acceptance of project schedule and task durations
 6. Site Safety Plan
 7. Submittal log
 8. Submittal data as defined below
 9. Drawing plot plan
 10. Coordination drawing log
 11. Proposed sub-contractors list
 12. Equipment manufacturers and material suppliers list
 13. Requests for substitution
 14. Manufacturer's Compliance reviews
 15. Contractor Certification forms
 16. Manufacturer's Certification forms
 17. List of samples to be submitted
 18. List of all permits to be provided
 19. List of all Engineers providing signoffs, certifications, and Controlled Inspections
 20. Sleeve and slab penetration drawings

21. Details and locations of embeds
22. Equipment pad location and sizing drawings
23. Drawings showing point loading of equipment and hung supports in excess of 200 pounds
24. Pipe and Conduit expansion drawings and calculations
25. Seismic support drawings
26. List of items proposed to be shop fabricated along with skid details (Provide spool details on request.)
27. Shop Standards
28. Material Standards
29. Welding procedures and list of certified personnel with record of certification of steam piping is the responsibility of this contractor. (Submit copies of all reports and approvals on completion.)
30. Coordination drawings
31. Testing procedures including deferred testing (seasonal or out of sequence based on maintaining job progress schedule)
32. Flushing connection and bypass arrangement drawings approved by BMS contractor and equipment manufacturer were flushing through valves, instrumentation, and equipment is proposed.
33. Final reports on all flushing and chemical treatment of systems approved by chemical treatment manufacturer prior to start-up.
34. Alignment reports
35. Manufacturer's factory test reports
36. Manufacturer's and contractor's start-up reports
37. All MSDS forms for materials brought on site
38. List of all fuse sizes prior to start-up
39. O&M manuals
40. As-built drawings

41. As-built reflected ceiling and floor drawings showing access door locations indicating type and nature of concealed device
 42. Manufacturer's standard warranty along with signed acknowledgement of modified terms per this contract
 43. Contractor warranty
 44. Training Outlines and Agenda
 45. Commissioning pre-functional testing forms
 46. Commissioning logs and test results
 47. Certified Project Record Documents
 48. Updated Equipment Schedule Sheets
 49. Notice of Completion
 50. LEED Building Requirements
- B. The Division 26 Contractor shall submit a complete typed list of all electrical equipment manufacturers and material suppliers for the equipment and materials they intend to furnish and install on this project for review by the Owner/Architect/Engineer prior to the award of the contract.
- C. Each Contractor shall prepare an index of all Division 26 submittals for the Project. The index shall include a submittal identification number, a cross-reference to the Specification Section or Drawing number and an item description. The submittal identification number shall be prefixed by the applicable Specification Section. Each submittal shall bear the submittal identification number in addition to the other data specified. All consultants, the Owner and all Contractors will utilize the assigned submittal identification number. If an expedited submittal review process is implemented on this Project, the equipment manufacturers, material suppliers list and submittals index will have to be submitted early to meet the requirements of the expedited submittal review procedure.
- D. Upon receipt of the approved manufacturers and material suppliers list, the Contractor shall immediately obtain complete Shop Drawings, Product Data and Samples and equipment and material Specification Compliance Review documents from the manufacturers, suppliers, vendors and all Division 26 Contractors, for all materials and equipment as specified herein in various sections of the specifications and shall submit data and details of such materials and equipment for review by the Architect and Engineer. Prior to submission of the Shop Drawings, Product Data and Samples to the Architect and Engineer, the Contractor shall thoroughly review the Shop Drawings, Product Data and Samples and verify they are in compliance with the Contract Documents. The Contractor shall provide a compliance review provided with the Contractor's Compliance Review will be a paragraph-by-paragraph review of the specifications

with the following information marked for each Specification section paragraph or in the margin of the original Specification and any subsequent Addenda.

1. “C”: Comply with no exceptions.
2. “D”: Comply with minor deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
3. “E”: Exception. Equipment, product or material does not comply. For each and every exception, provide a numbered footnote with reasons for each exception and suggest possible alternatives for the Owner’s consideration.
4. “N/A”: The specification paragraph does not apply to the proposed equipment, material or product.
5. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Contractor is in complete compliance with the Contract Documents. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not.
6. The Contractor shall check all materials and equipment upon their arrival on the Project Site and verify their condition and compliance with the Contract Documents. Any work, which proceeds prior to receiving “Approved”, Shop Drawings shall be modified as required to comply with the Contract Documents and the “Approved” Shop Drawings. A minimum period of fifteen (15) working days, exclusive of transmittal time, will be required in the Engineer’s office each time a Shop Drawing, Product Data and/or Sample is submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling his work.
7. The review of Shop Drawings, Product Data, and Samples by the Architect and Engineer shall not relieve the Contractor of the responsibility for dimensions of errors that may be contained therein for deviations from requirements in the Contract Documents. It shall be clearly understood that the noting of some errors by the Engineer but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, Product Data and Samples, the Contract Documents shall govern the Work and are neither waived nor superseded in any way by the review of Shop Drawings, Product Data, and Samples.
8. The Contractor shall observe the following procedures when submitting Shop Drawings, Product Data, and Samples:
 - a. Shop Drawings - Each Shop Drawing shall indicate in the lower right hand corner and each Product Data brochure shall indicate on the front cover of the following: the submittal identification number; title of the sheet or brochure; name and location of the Project; names of the Architect, Engineer, Contractor, Subcontractor,

manufacturer, supplier and vendor; the date of submittal and the date of each correction and revision. All pages and drawings in Product Data brochures shall be numbered consecutively from beginning to end. So far as is practical, each Shop Drawing, Product Data and/or Sample shall bear a cross reference note to the page number or numbers of the sheet of the Drawings and/or Specifications showing the Work. Unless the above information is included, the submittal will be returned for re-submittal. Re-submittals of Product Data or brochures shall be complete and shall include a cover letter summarizing the corrections made in response to the review comments and the submittal page numbers, which were revised.

- b. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections and schematics to clearly describe the work. Drawings shall be prepared by a drafter or CAD technician skilled in this type of work. All sheet metal, piping, fire protection and similar Shop Drawings shall be drawn to at least 1/8" = 1'-0" scale. The Contractor shall submit Shop Drawings as described below. Shop Drawings, which do not comply with these requirements, will be returned for re-submittal.

The submittal shall consist of one (1) direct reading, clearly legible, paper sepia of each Shop Drawing. The Architect and Engineer will each review the paper sepia Shop Drawings. After review of the Shop Drawings, blue line prints will be produced from the registered paper sepia. The Shop Drawing(s) as marked by the Engineer, shall require the following action:

- c. "APPROVED" means that fabrication; manufacture, installation or construction may proceed in compliance with the Submittal and the Construction Documents.
 - 1) Six (6)-blue line prints from the reviewed registered sepia will be returned to the Contractor.
 - 2) The paper sepia will not be returned.
 - 3) No additional submittal is required for the "APPROVED" Shop Drawings.
- d. "APPROVED AS NOTED" means that fabrication, manufacture, installation or construction may proceed in compliance with the Submittal, as annotated by the Engineer, and the Construction Documents, and, if noted, the contractor shall revise and resubmit the Submittal to incorporate the Engineer's annotated comments. If, for any reason, the Contractor shall make revisions to the Submittal in comments, the Contractor shall make revisions to the Submittal in order to incorporate those comments with which it can comply and resubmit the revised Submittal with a statement setting forth the comments with which it cannot comply and the reasons therefore.
 - 1) The Owner, Architect, and Engineer will each retain one (1) blue line print.
 - 2) Six (6) blue line prints from the reviewed registered sepia will be returned to the Contractor.
 - 3) The paper sepia will not be returned.

- 4) The Contractor shall forward a written response to the items noted within fourteen (14) days of the Engineer's review date stamped on the Shop Drawing. The response must be certified as specified. Upon receipt of a satisfactory response, the status of the submittal will be revised to "APPROVED" by a written document to the Contractor prepared by the Engineer. If the response is not received by the Engineer in (14) days of the Engineer's review date stamped on the submittal, the "APPROVED" status will be rescinded by a written document to the Contractor prepared by the Engineer.
9. "REVISE AND RESUBMIT" means that a portion of the Submittal does not comply with the design intent of the Construction Documents. Other portions of the Submittal, as noted, may proceed with fabrication, manufacture, installation or construction in compliance with the Submittal, as annotated by the Engineer, and the Construction Documents. The Contractor shall revise or replace the disapproved portions of the Submittal as noted and resubmit the entire revised or replaced Submittal.
 - a. The Owner, Architect, and Engineer will each retain one (1) blue line print.
 - b. The reviewed registered paper sepia will be returned to the Contractor.
 - c. The submittal shall be corrected in accordance with Contract Documents and resubmitted in whole for review. Note: The returned paper sepia stamped "REVISE AND RESUBMIT" may not be resubmitted.
 - d. If the submittal is returned to the Contractor marked "DISAPPROVED," only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
10. "DISAPPROVED" means that the Submittal does not comply with the design intent of the Construction Documents. Submittals stamped "Disapproved" are not to be used. The Contractor shall revise and resubmit the Submittal.
 - a. The Owner, Architect, and Engineer will each retain one (1) blue line print.
 - b. The reviewed registered paper sepia will be returned to the Contractor.
 - c. The submittal shall be corrected in accordance with Contract Documents and resubmitted in whole for review. Note: The returned paper sepia stamped "DISAPPROVED" may not be resubmitted.
 - d. If the submittal is returned to the Contractor marked "DISAPPROVED", only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
 - e. Subsequent submittals of any Shop Drawing previously marked "NOT APPROVED, REVISE AND RESUBMIT" shall have all corrections or other revisions clearly identified.

- f. If the copy stamped "APPROVED" is altered for any reason after it has been stamped, the "APPROVED" shall automatically be voided.
 - g. All work shall be done in accordance with Shop Drawings stamped "APPROVED" insofar as these are in agreement with the Contract Documents. The "APPROVED" Shop Drawings shall be used in conjunction with the preparation of the Coordination Drawings specified hereinafter. Wherever differences occur between the Shop Drawings and the Contract Documents, the Contract Documents shall govern the work.
11. Product Data - Product Data Submittals to be submitted shall be published by the manufacturers and shall contain complete and detailed engineering and dimensional information. The Contractor shall submit Product Data as described below. Product Data, which does not comply with these requirements, will be returned for re-submittal.

Product Data submittals shall contain only information relevant to the particular equipment or materials to be furnished. The Contractor shall not submit catalogs, which describe several different items in addition to those items to be furnished and installed on this project, unless all irrelevant information is marked out or relevant information is clearly marked. Where applicable, equipment Product Data shall include wiring and interlock diagrams using the standard wiring diagrams with all terminal which have been provided for use by the Division 16 and/or BMS Contractors clearly indicated. All microprocessor-based equipment shall have Open Protocol and all information relative to the interface requirements and set-up shall be provided. Refer to the Electrical Drawings for additional information.

The submittal shall consist of Product Data from each manufacturer. Contractor shall provide ten (10) copies for review unless instructed otherwise by the CM. The Shop Drawing(s) as marked by the Engineer, shall require the following action:

- a. "APPROVED" means that fabrication, manufacture, installation or Construction may proceed in compliance with the Submittal and the Construction Documents.
 - 1) The Owner, Architect, Engineer, and CA will each retain one (1) copy. The CM will retain four (4) copies for their records and coordination with other consultants and trades.
 - 2) Two (2) copies from the reviewed submittal will be returned to the Contractor.
 - 3) The Contractor shall resubmit the entire submittal for record purposes.
 - 4) The revised submittal shall be reviewed and confirmed to be compliant by the Engineer. The submittal, if fully compliant, shall be returned marked "APPROVED".
 - 5) If the submittal is returned to the Contractor marked "APPROVED AS NOTED", only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.

- b. "REVISE AND RESUBMIT" means that a portion of the Submittal does not comply with the design intent of the Construction Documents. Other portions of the Submittal, as noted, may proceed with fabrication, manufacture, installation or construction in compliance with the Submittal, as annotated by the Engineer, and the Construction Documents. The Contractor shall revise or replace the disapproved portions of the Submittal as noted and resubmit the entire revised or replace Submittal.
- 1) The Owner, Architect, Engineer, and CA will each retain one (1) copy. The CM will retain four (4) copies for their records and coordination with other consultants and trades.
 - 2) Two (2) copies from the reviewed submittal will be returned to the Contractor.
 - 3) The Contractor shall resubmit the entire submittal for review.
 - 4) The revised submittal shall be reviewed and confirmed to be compliant by the Engineer. The submittal shall be returned marked by the Engineer.
 - 5) If the submittal is returned to the Contractor marked "REVISE AND RESUBMIT", only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
- c. "DISAPPROVED" means that the submittal does not comply with the design intent of the Construction Documents. Submittals stamped "DISAPPROVED" are not to be used. The Contractor shall revise and resubmit the Submittal.
- 1) The Owner, Architect, and Engineer will each retain one (1) blueline print.
 - 2) The reviewed registered paper sepia will be returned to the Contractor.
 - 3) The submittal shall be corrected in accordance with Contract Documents and resubmitted in whole for review. Note: The returned paper sepia stamped "DISAPPROVED" may not be resubmitted.
 - 4) If the submittal is returned to the Contractor marked "DISAPPROVED", only one (1) additional submittal will be permitted without the Contractor incurring charges for the additional re-submittals. The Owner shall be reimbursed by the Contractor for any expense in connection with any necessary submission in addition to the two (2) submissions set forth hereinbefore.
 - 5) Subsequent submittals of any Shop Drawings or Product Data Submittal requiring resubmission shall have all corrections or other revisions clearly identified.
 - 6) If the copy stamped "APPROVED" is altered for any reason after it has been stamped, the "APPROVED" shall automatically be voided.
 - 7) All work shall be done in accordance with Shop Drawings and/or Product Data stamped "APPROVED" insofar as these are in agreement with the Contract Documents. The "APPROVED" Shop Drawings shall be used in conjunction with the preparation of the Coordination Drawings specified

hereinafter. Wherever differences occur between the Shop Drawings and the Contract Documents, the Contract Documents shall govern the work.

- 8) Initial transmittal of manufacturer's data shall include two (2) copies of installation manuals and wiring diagrams.
 - 9) If not called for or defined in a particular specification section provide submittal data called for in "EQUIPMENT NOISE AND VIBRATION".
- d. Prior to assembling or installing the work, the following shall be submitted by the contractor for review by the Engineer:
- 1) Scale drawings indicating insert and sleeve locations.
 - 2) "Approved" Equipment and Material Submittal.
 - 3) Completed Coordination drawings signed by all trades and reviewed by the Engineer.
 - 4) "Approved" Submittals.
 - 5) Coordination drawings for access panel and door locations.
 - 6) Shop drawings detailing fabrication and installation for supports for mechanical materials and equipment.
 - 7) Composite wiring diagrams.
- e. Documents will not be accepted for review unless:
- 1) They include complete information pertaining to appurtenances and accessories.
 - 2) They are submitted as a package where they pertain to related items.
 - 3) The submittal package is complete, containing all information required under the contract documents.
 - 4) They are properly marked with service or function, project name, where they consist of catalog sheets displaying other items, which are not applicable.
 - 5) They indicate the project name and address along with the Contractor's name, address and phone number.
 - 6) They are properly marked with external connection identification as related to the project where they consist of standard factory assembly or field installation drawings.
- f. Shop Drawing Review
- 1) The purpose of the review of shop drawings is to maintain integrity of the design. Unless the contractor clearly points out changes, substitutions, deletions or any other differences between the submission and the Contract Documents in writing on the Contractor's compliance review form, approval and/or review by the Engineer or Architect does not constitute acceptance. It is not to be assumed that the Engineer has read the text nor reviewed the technical data of a manufactured item and its components except where the Vendor has pointed out differences on the Contractor's compliance review form between his product and the specified equipment, material or product.

Any notations or markings on shop drawings made by the Architect/Engineer, which Contractor considers a change shall be immediately brought to the attention of the CM by submitting a formal Change Order Request. Procedure of fabrication of installation prior to such notification shall be at this Contractor's risk.

- 2) It is the responsibility of the contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by him with other trades during the preparation of the contractor's coordination drawings. Final Review of shop drawings containing errors does not relieve the contractor from making corrections at his expense.
- 3) No shop drawings stamp or note shall constitute an order to fabricate or ship.
- 4) The Contractor is responsible for seeing that "Approved" copies of shop drawings bearing the approval of the Architect/Engineer or Owner's Consultant are kept on the job site and work is implemented in the field in accordance with these documents.
- 5) Where information from one Contractor is required by another contractor, it is the responsibility of the contractors to exchange information and coordinate their work.

1.10 COORDINATION DRAWINGS

- A. The Contractor and all Subcontractors shall prepare a complete set of construction coordination drawings ("Coordination Drawings") indicating the equipment actually purchased and the exact routing and elevations for all lines such as piping, busway, conduit, ductwork, etc., including conduit embedded in concrete and openings, sleeves, etc., required in the structure, walls, partitions, etc.
- B. The Coordination Drawings shall be submitted complete for demonstration of compliance to the Architect, Engineer, and Owner. All structural elements, footings, slab elevations and thickness shall be indicated.
- C. The sheet metal drawings prepared on electronic media (CAD) at a scale not less than $3/8" = 1'-0"$, shall serve as the base Drawings to which all other Contractors will overlay and add their Work. Each trade shall draw their Work on separate layers represented by individual colors. Each Coordination Drawing shall be completed and signed off by the other Contractors and the Contractor prior to the installation of the Work in the area covered by the specific Coordination Drawing.
- D. Any Work installed before coordinating with the Work of the other trades, shall be subject to removal and re-installation as required to correct the condition without extra cost to Owner.
- E. The Coordination Drawings shall indicate piping, conduit, busway and equipment support points and loads exceeding 500 lb. imposed on the building structure. Drawings shall be submitted to the Architect and Engineer of record for review. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points

and the size of all lines shall be indicated. All beam penetrations, slab penetrations and sleeves shall be indicated, sized and coordinated with all other Work. All required code clearance space and required maintenance access space shall be indicated and coordinated with all other work. All Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated.

1.11 RECORD DOCUMENTS

- A. The Contractor shall maintain on a daily basis at the Project Site a complete set of Project Record Documents. The Project Record Documents shall consist of continuously updated AutoCAD files of the Coordination Drawings for this Division. The AutoCAD files shall be electronically updated by the Contractor's technician during the construction period to show the precise location of all buried or concealed work and equipment, including embedded piping and valves, field modifications and all changes and deviations in the Mechanical work from that shown on the Contract Documents.
- B. The Contractor shall maintain on site a record of testing records, and pre-functional and functional testing forms and records.
- C. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without written definite instructions from the Architect or Engineer. Prior to commencing work, the Contractor shall obtain from the Architect or Engineer a set of AutoCAD format Drawings on compact disks, to be used only to produce the Coordination Drawings. The continuously updated Coordination Drawings shall be used to produce the final Project Record Documents, which shall be delivered to the Owner in latest version AutoCAD format CD-RW Recordable Rewrite Compact Discs upon Final Completion of the Project. The Contractor shall give to the Architect and Engineer a written release acceptable to the Architect and Engineer signed by a corporate officer of the Contractor prior to receipt of the Architect's and Engineer's compact disks.
- D. Record dimensions shall clearly and accurately delineate the work as installed; locations shall be suitable identified by at least two (2) dimensions to permanent structures.
- E. Prior to final acceptance of the work of this Division, the Contractor shall submit properly certified Project Record Documents to the Architect and Engineer for review and shall make changes, corrections or additions as the Architect and/or Engineer may require to the Project Record Documents. After the Architect's and Engineer's review and any required Contractor revisions, the Project Record Documents shall be delivered to the Owner on CD-RW Recordable Rewrite Compact Discs in latest AutoCAD format.
- F. Prepare project record documents in accordance with the requirements in Division 1 and as specified herein. In addition, comply with the following:
 - 1. A complete set of "as-built" or record drawings shall be made up and delivered to the Architect.

2. The drawings shall show:
 - a. All conduit systems with raceways 2" and over.
 - b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - c. Actual equipment and materials installed.
 - d. This trade shall submit the as-built project record documents set for approval by the building department in a form acceptable to the department, when required by the jurisdiction.
 - e. "As-built" electrical riser diagram.
 - f. "As-built" grounding system schematic diagram.
 - g. "As-built" panel schedules.
 - h. "As-built" branch circuiting including lighting, general power, receptacle, and mechanical equipment circuiting.

1.12 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall provide operating instructions and maintenance data books for all equipment and materials furnished under this Division as well as assist the CA in compiling and consolidating O&M information during the development of the site-specific Commissioning Plan.
- B. Deliver two (2) initial copies of the operation and maintenance manuals to the Owner and Engineer for review with the equipment submittals. The initial copies shall contain all the information available at the time of submission.
- C. Submit six (6) final copies of operation and maintenance manuals to the Owner and Engineer for review at least two (2) months prior to training along with the training outlined. Assemble all data in a completely indexed volume or volumes in three ring binders and identify the size, model and features indicated for each item. The binders shall have the Project Name and Logo printed on the outside of the binders. Re-submittals of these final size (6) copies of the "Approved" operation and maintenance books and two (2) electronic CD-RW recordable rewrite compact disc shall be delivered to the Owner upon Final Completion of the Project.

Vendor / Manufacturer shall supply complete operations and maintenance manuals in accordance with the following requirements:

1. The operations and maintenance manual documentations shall be presented in an Avery 3" heavy duty white binder or equivalent at the time of original submission, and record manuals within four weeks of integrated delivery of equipment to the site.
2. The binder shall have a cover page depicting the system(s) covered by the manual, the Owner's name, site location, and date.
3. The binder shall contain a detailed table of contents page delineating all major sections of the manual. Each section of the manual shall have an Avery narrow tab type divider placed

between sections (properly labeled) to ensure easy access. The major sections of the manual shall include:

- D. Include the following information where applicable:
1. Manual index
 2. Specification Section reference number and index.
 3. Equipment and/or material model number and serial numbers.
 4. Identifying name, mark number, plan/drawings tagging, etc.
 5. Locations of major equipment (where several similar items are used, provide a list).
 6. Manufacturer's catalogue literature including model, type, style, complete standard factory operations manual, brand name data, etc.
 7. Installation manual
 8. Operations manual
 9. Maintenance manual with recommended periodic maintenance and schedules.
 10. Detailed sequences of operation for all operating modes.
 11. Supplier, dealer, distributor, vendor and service organizations including phone, fax and e-mail addresses and name of contact person.
 12. "Approved" or approved submittals.
 13. Dimensional drawings with equipment weights.
 14. List of spare parts recommended for normal service requirements.
 15. Assembly and disassembly instructions with exploded view Drawings where available.
 16. Manufacturer's recommended operation and maintenance instructions with all non-applicable information deleted.
 17. Trouble shooting diagnostic instructions where available.
 18. Copy of all warranties and guarantees.
 19. Copy of all factory and field test reports.
 20. Completed Functional Test sheets.
 21. Completed Pre-functional checklists.
 22. All feeder loads and balancing.
- E. Items required for inclusion in the operations and maintenance manuals that cannot be provided at the time the O&Ms are initially submitted for review are expected to be submitted within ten (10) weeks of completion of the work in a format for insertion into the binder under a pre-fabricated tab that is identified in the table of contents (i.e., the site acceptance test may not be complete at the time this manual is required for submission, in this case the manufacturer shall submit the manual with this section empty, upon completion of the site acceptance testing the forms for this testing will be supplied (punched for the binder)).
- F. All documents shall be submitted electronically by computer disk in a dedicated sleeve within the binder.

1.13 CODES, PERMITS AND INSPECTIONS

- A. All work shall meet or exceed the latest requirements of all national, state, county, municipal and other authorities exercising jurisdiction over construction work at the project. These include, but are not limited to the following:
 - 1. NFPA National Fire Codes
 - 2. New York State Department of Health
 - 3. Building Code of New York State
 - 4. Fire Code of New York State
 - 5. White Plains Electrical Code
 - 6. White Plains Fire Department
- B. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the work.
- C. Any portion of the work, which is not subject to the approval of any authority having jurisdictions, shall be governed by the applicable sections of the overall National Fire Code, as published by the National Fire Protection Association.
- D. All equipment furnished as part of the electrical work shall comply with the latest editions of all applicable state and municipal "energy codes." Provide certification from the equipment suppliers for all energy-consuming equipment that the energy-consuming equipment that the equipment fully complies with these codes. Equipment submissions will not be accepted for review unless accompanied by such certification in writing.
- E. Installation procedures, methods, and conditions shall comply with the latest requirements of The Federal Occupational Safety and Health Act (OSHA).
- F. Provide and pay for the cost of the filing of the fire alarm systems and all required Inspections as called for in the Building Code of New York State, and as required by the White Plains Fire Department. Submit the name of the registered Professional Engineer who will be responsible for making the inspections and for withdrawing the design engineer as the design applicant and re-filing as the design applicant as soon as possible or within 90 days of the award of contract for approval by the Engineer and Owner, file with the building department.
- G. Prepare and submit to the building department a set of as-built project record documents record drawings for approval, in a form acceptable to the building department.
- H. This Contractor shall prepare all plans, amendments and pay all filing fees that will be required for the fire alarm system under the jurisdiction of the controlling agencies.
- I. This Contractor shall be responsible for the installation and filing until the installation has been approved by the authorities having such jurisdiction.

- J. Kitchen fire extinguishing system is to be filed by contractor where required by the controlling agency.

1.14 COORDINATION OF WORK BETWEEN TRADES

- A. The Electrical Trade is required to supply all necessary supervision and coordination information to any other trades who are to supply work on the project.
- B. The Electrical Trade is required to supply all necessary supervision and coordination of all other trades required for the storage, transportation, installation, start-up, testing and commissioning of pre-purchased equipment.
- C. Where the Electrical Trade is required to install items, which it does not purchase, including pre-purchased equipment, it is required that this contractor assumes all responsibilities associated with the equipment as if they had purchased the equipment directly. This shall include but is not limited to the following:
 - 1. The coordination of their delivery including prior notifications and overseeing the filing of all claims.
 - 2. Equipment is to be purchased inclusive of freight to an initial point of delivery. Contractor is to coordinate and assumes all costs for receipt at, storage at, and transportation to the site from a rigger's yard.
 - 3. Their unloading from delivery trucks driven into any designated point on the property line at grade level.
 - 4. Their safe handling and field storage up to the time of permanent placement in the project.
 - 5. Their protection and periodic maintenance up to the time of Owner takeover of these responsibilities as defined by start-up, Owner acceptance, and warranty conditions defined herein.
 - 6. The correction of any damage, defacement or corrosion to which they may have been subjected.
 - 7. Their field assembly and internal connection as may be necessary for their proper operation.
 - 8. Their mounting in place including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
 - 9. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
 - 10. All labor including but not limited to installation, start-up, commissioning, and warranty.
 - 11. Any and all documentation to be provided as required by the contract documents.
- D. Items which are to be installed but not purchased as part of the work of the Electrical Trade shall be carefully examined by this trade upon delivery to the project. Claims that any of these items have been received in such condition that deviates from information previously provided that their installation will require procedures beyond the reasonable scope of work of the Electrical Trade will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The work of the Electrical Trade shall include all procedures,

regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

- E. The contractor shall review work required by all trades and coordinate the installation of the contractor's work as follows:
 - 1. Prior to submission of the contractor's formal bid, this contractor shall review all construction documentation of the project and any related projects. The contractor shall notify the general contractor of work required in the contractor's bid which is indicated or implied in other sections of the work.
 - 2. During construction, this contractor shall coordinate the contractor's work with work of all trades to insure proper installation of the contractor's work.
- F. Coordinate exact locations of all low-voltage devices, wiring devices, fire alarm, and receptacles with architectural drawings. Final low-voltage (AV, IT, Security, as applicable) device locations and conduit requirements to be coordinated with low-voltage vendors prior to installation.
- G. Where multiple contracts are awarded involving the same trade for either base contract work or tenant fit-out, contractors shall coordinate their work and provide sufficient labor for the testing of the system as a whole.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Unit shall be stored and handled in accordance with manufacturer's instructions.
- C. Unit shall be shipped with all listed items and control wiring factory installed unless noted on the submittals and approved prior to shipment.
- D. Unit shall be shipped complete as specified. Parts for field installation shall not be shipped and stored on site without prior to shipment.
- E. Rigging: Units shall be fully assembled. Units requiring disassembly for rigging shall be factory assembled and tested. Disassembly, reassembly and testing shall be supervised by the manufacturer's representative.
- F. Unit shall be shipped with firmly attached labels that indicate name of manufacturer, model number, serial number, and plan tagging.
- G. The Vendor shall shrink-wrap all electronic equipment and spare parts prior to shipping. Spare parts are to be delivered at time of Owner acceptance.

1.16 PRECONSTRUCTION CONFERENCE PRIOR TO START OF WORK

- A. Prior to commencing any work, the CM, together with designated major Contractors, shall confer with the Architect and Engineer concerning the work under the Construction Contract.
- B. The pre-construction conference will be conducted under the leadership of the CM and will occur soon after the CM notifies the Subcontractors of contract award. The pre-construction conference will focus on items such as the expedited submittal review procedure, interface and coordination between Contractor work scope, the CM's project site rules and requirements, temporary utility requirements, CM's construction schedule, etc.
- C. Prior to start of work and prior to preparation of any submittals there shall be an interface meeting between fire alarm contractor, HVAC contractor, controls contractor and VFD vendor to coordinate hardwired safeties, fire alarm, and BMS monitoring termination points.

1.17 GUARANTEES, CERTIFICATIONS, AND WARRANTY PERIOD

- A. Contractors and their manufacturers shall provide a 1-year full parts and labor warranty. Contractor must maintain a local full-time service company with 24-hour emergency service capable of responding to service needs within 4 hours. Contractor shall be aware that during the full warranty period as defined above, Manufacturers of certain pre-purchased equipment as called for in purchase agreements by the CM are to provide all required periodic and routine service and maintenance. The Manufacturers through the Contractor shall submit a service and maintenance plan for approval by the Owner. The Manufacturer must comply with the requirements of Owner's Service Contract terms and conditions. When purchase agreements are made the responsibility of this Contractor, all service agreements called for in specification sections shall be made part of the initial purchase and shall pass directly to the Owner. All other equipment, systems and related appurtenances shall be the responsibility of the Contractor for warranty. All warranty claims whether for pre-purchased or direct purchased equipment shall be the responsibility of the Contractor.
- B. During the warranty period, the Contractor shall guarantee the following in a form satisfactory to the Owner:
 - 1. All work installed will be free from any and all defects in Workmanship and/or materials.
 - 2. All apparatus will develop capacities and performance characteristics specified.
 - 3. The systems shall operate without malfunction.
- C. The Contractor shall, without cost to the Owner, remedy any defects within a reasonable time to be specified in notice from the Architect. In default thereof, the Owner may have such Work done and charge all costs to the Contractor.
- D. The start of the Contractor's warranty period, as defined above, shall have no restrictions on start date and extend for the full period noted.
- E. The Contractor shall confer with the CM prior to the bid date concerning the Schedule and determine if there is a need to operate any items of equipment or systems for temporary heating

and/or cooling or other reasons prior to substantial completion. All required extended warranty costs for equipment, materials and systems shall be included in the Contractor's proposal and clearly designated with a breakout price. All equipment or systems used for temporary heating and/or cooling shall be restored to "as new" condition by this Contractor and all associated costs shall be included in the Contractor's bid proposal.

1.18 CONNECTIONS TO EXISTING WORK

- A. Plan installation of new work and connections to work previously installed or put in place by others to insure minimum interference with regular operation of existing and surrounding facilities. Submit to the Owner for approval, date schedule of necessary temporary shutdowns of existing services. All shutdowns shall be made at such times as will not interfere with regular operation of existing facilities and only after written approval of Owner. To insure continuous operation, make all necessary temporary connections between new and existing work. All costs resulting from temporary shutdowns shall be borne by this Contractor.
- B. Prior Inspection During Bid. Provide a minimum 48-hours of notice for any shutdown requirements. Coordinate all shutdown requirements with building owner. Contractor shall coordinate all riser and building equipment shutdowns with building owner prior to commencement of shutdown.
- C. All shutdowns shall be done on overtime.
- D. The drawings may not utilize symbols and schematic diagrams to indicate connections to existing work. If used, these do not have any dimensional significance nor do they delineate every item required for the intended installations nor do they represent a division of responsibility between contracts.
- E. The contractor shall coordinate all connections to existing work with the CM. Contractor shall field verify exact location of all existing services.
- F. Connect new work to existing work in neat and approved manner. Restore existing work disturbed to original condition.
- G. Prior to demolition of scope of work area, equipment/devices/lighting fixtures outside of scope of work area that are served by scope of work area are to be tested for proper function under this scope of work.

1.19 FINAL REVIEW AND ACCEPTANCE

- A. At a time designated by the Owner and after Commissioning of the systems, the entire system will be reviewed for compliance with the Contract Drawings and Specifications. The Contractor shall be available at all times during this review.

- B. Prior to the Final Review field visit, the Contractor will submit to the Engineer a written certification that: 1) attests to the Contract Document compliance for this Project prior to the Engineers Final Review field visit, and 2) certifies that the equipment and materials installed in this project under this Division contain no asbestos or P.C.B.
- C. Operate the entire system properly with all loads balanced and all controls adjusted for a minimum period of ten (10) days.
- D. Certificates and Documents required herein to be in order and presented to the Engineer at least two (2) weeks prior to the Final Review.
- E. After the Final Review, any changes or corrections noted as necessary for the work to comply with the requirements of the contract documents are to be accomplished without delay in order to secure final acceptance of the work.

1.20 OPERATING INSTRUCTIONS AND TRAINING

- A. This Contractor shall be responsible for the training of Owner personnel for both the equipment and systems this Contractor installs as well as responsible to participate in the training of all systems that interfere with the work of other Contractors and Vendors. The Contractor shall, in addition to start up services, provide factory trained specialists to supervise commissioning and instruct the Owner's operators during operating instruction periods. This shall include, when applicable, participation in LEED™ requirements for near end of warranty re-commissioning as called for in the commissioning sections of the specification.
- B. Training shall consist of a minimum numbers of hours as listed below (minimum of 4 hours if not shown) of Owner instructions. Days shall not be defined as 8-hour periods, shall not be consecutive, and are separate and apart from start-up and commissioning. This shall consist of both classroom and in-the-field training. All training materials and a training curriculum unique to this project will be presented to the Owner 2 months in advance of the on-site training. Training will commence only after the approval of the curriculum and agenda by the Owner and the CA. The Owner may wish to videotape the on-site training. The Contractor and their vendors agree to allow videotaping of instruction periods. Include in addition to the periods of training listed:
 - 1. Periods at night for training of night shift personnel.
 - 2. Periods for use of the equipment for temporary Heating and Cooling.
 - 3. Periods to be present during Owner instruction on the BMS.
 - 4. Periods of training on major vendor furnished components such as switchboards and Automatic Transfer Switches, Dimming Systems, Occupancy sensor systems, Intelligent lighting Panels, etc.
- C. The Contractor shall commence no instruction period until all requirements of this section are met and the Owner has issued his written acceptance of the Contractor's submitted agenda, starting time and Schedules.

- D. The CM shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
- E. The electrical contractor shall provide the CA with a training plan at least two months before the planned training according to the following outline:
1. Equipment (included in training)
 2. Intended audience
 3. Location of training
 4. Objectives
 5. Subjects covered (description, duration of discussion, special methods, etc.)
 6. Duration of training on each subject
 7. Instructor qualifications and experience for each subject
 8. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
 9. Instructor and qualifications
- F. Training shall include:
1. Use of the printed installations, operation and maintenance instruction material included in the O&M manuals.
 2. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include startup, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 3. Include a review of all systems using the simplified system schematics, riser, and one-line drawings.
 4. Include a review of all as-built drawings.
 5. Basic engineering principals of operation for each piece of equipment.
 6. Performance of equipment under different environmental and operating conditions.
 7. Equipment submittal data and performance curves.
 8. Equipment construction.
 9. Equipment safeties and alarms.
 10. Equipment alarm and program settings.
 11. Operation limitations/restrictions.
 12. Operation modes/(response-action format).
 13. Failure modes/(response-action format).
 14. Maintenance modes/(response-action format).
 15. Control power and appurtenances.
 16. Include field walk-throughs to locate all concealed devices, review valve, duct and pipe tagging method, review equipment locations and tagging.
 17. Discussion of relevant health and safety issues and concerns.
 18. Discussion of warranties and service contracts.
 19. Common troubleshooting problems and solutions.
 20. Location of all plans and manuals in the facility.

- G. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative.
- H. The Controls Contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
- I. Hands-on training shall include start-up, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance for all pieces of equipment.
- J. The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central building control system.
- K. The electrical contractor shall provide training on each piece of equipment according to the following schedule:

<u>Hours</u>	<u>System</u>
8	Utility and Service Switchgear
8	Building Distribution
4	Occupancy Sensors
8	Intelligent Panelboards
8	Automatic Transfer Switches
8	Transient Voltage Suppression Systems
8	Dimming Systems
48	Fire Alarm System
4	Electronic Faucets & Flush-O-Meters
8	Miscellaneous Building Electrical Components

1.21 LIMITING NOISE PRODUCED BY ELECTRICAL INSTALLATIONS

- A. Perform the following work in accordance with field instructions issued by the Architect to assure that minimal noise is produced by electrical installations due to equipment furnished as part of the electrical work.
- B. Check and tighten the fastenings of sheet metal plates, covers, doors and trims used in the enclosures of electrical equipment.
- C. Remove and replace any individual device containing one or more magnetic flux path metallic cores (e.g., discharge lamp ballasts, transformer reactor, dimmer, solenoid) which is found to have a noise output exceeding that of other identical devices installed at the project.

1.22 MOUNTING HEIGHTS

- A. Heights of wall mounted receptacles, lighting controls, fire alarms devices and equipment shall be as indicated on Architectural plans.
- B. Architectural drawings and field instructions issued by the Architect take precedence over the above and shall be adhered to.
- C. Mounting heights of pendant mounted lighting fixtures shall be as directed in the field by the Architect.

1.23 LOCATING AND ROUTING CIRCUITRY

- A. All circuitry shall be run concealed except that is shall be run exposed:
 - 1. Horizontally at the ceiling of permanently unfinished spaces which are not assigned to mechanical or electrical equipment.
 - 2. Horizontally and vertically in mechanical equipment spaces.
 - 3. Horizontally and vertically in electrical rooms.
- B. Concealed circuitry shall be so located that building construction materials can be applied over its thickest elements without being subject to spalling or cracking.
- C. Outlet boxes, couplings, fittings and the like associated with circuitry runs which meet the above requirements will not be excluded from embedment in the concrete.
- D. Circuitry runs embedded in field poured structural building construction concrete fill shall conform to the following:
 - 1. They shall be run "single layer" with their outside surface no closer there 1" to any surface of the structural concrete.
 - 2. They shall not be located in any configuration which places the outside surface of one closer than 3" to the outside surface of another, except at tees, crosses or other single level wide angle junction points.
 - 3. Where crossovers or close groupings are unavoidable, circuits shall either be dog-legged out of the concrete or be carefully field coordinated so as not to cause structural weakness.
 - 4. Where turned up or down into a wall or partition, they shall, before entering same, be routed parallel for a long enough distance to assure that no relocation of the wall or partitions will be necessary to conceal the required bend.
 - 5. They shall be routed in such a manner as to coordinate with the structural requirements of the building.
 - 6. They shall be routed in accordance with instructions issued by the Architect where such instructions differ from the specification set forth herein.
- E. Circuitry run exposed shall be routed parallel to building walls and column lines.
- F. Exposed circuitry located overhead shall be run in a completely accessible manner.

- G. Circuitry run in suspended ceilings may be routed “as the crow flies”, except that where such circuitry has to be installed before complete information regarding final layouts of all trades occupying the suspended ceiling space is available, it shall be routed in coordinated “spared off” manner so as to minimize future conflicts.
 - H. Circuitry shall be routed as so to prevent electric conductors from being subjected to high ambient temperature. Minimum clearances from heated lines or surfaces shall be maintained as follows:
 - 1. Crossing where uninsulated 0'-3"
 - 2. Crossing where insulated 3'-0"
 - 3. Running parallel where uninsulated..... 3'-0"
 - 4. Running parallel where insulated..... 0'-6"
 - I. Circuitry shall not be routed over or under a boiler except where special provisions for wiring through these specific high ambient temperature areas have been indicated.
 - J. Circuitry shall not be run in elevator shafts, hoistways and the like. Where outlets for traveling cables, pit lights, run by level lights and the like, are involved, only “final connections” outlet boxes themselves shall be located within or open into, the confines of the shaft.
 - K. Circuitry for miscellaneous systems indicated without notation as to location and routing shall be runs as per the requirements and notations governing the adjacent light and power circuitry.
 - L. Circuitry to be separately supported. Supports may not be shared by other systems including mechanical, plumbing, and sprinkler ductwork and piping systems.
 - M. Circuitry must be secured tight to the building structure where possible. Circuitry may not rest above hung ceilings or above other building systems including mechanical, plumbing, and sprinkler ductwork and piping systems.
- 1.24 INSTALLING CIRCUITRY
- A. The outside surface of circuitry which is to be embedded in cinder concrete shall be coated with asphaltum paint.
 - B. In runs of conduit or raceway including flexible conduit, limit the number of bends between cable access points to a total which does not exceed the maximum specified for the particular system. Where no such maximum is specified, limit the number to four right angle bends or the equivalent thereof.
 - C. Provide all cutting, core drilling, chasing of concrete and other finishes to install work in a concealed manner. This contractor shall not do any cutting, coring or chasing that may impair the

strength of the building. All work shall be done in a workman-like manner by mechanics skilled in their trade.

- D. In each empty conduit or raceway assigned for future pulling in of wires, include a nylon drag cord. In raceways 2" trade size and larger, the cord shall be pulled in utilizing a suitable brush, followed by an 85% diameter ball mandrel ahead of the cord in the pulling assembly. In the event that obstructions are encountered, which will not permit the drag cord to be installed, the blocked section raceway shall be replaced and any cutting and patching of the structure involved in such replacement shall be included as part of the electric work.
- E. Circuitry shall be arranged such that conductors of one feeder or circuit carrying "going" current are not separated from conductors of the same feeder or circuit carrying "return" current by any ferrous or other metal. Where not within raceways, all "going" and "return" current conductors of one feeder or circuit shall be laced together so as to minimize induction heating of adjacent metal components.
- F. Sleeves used where circuitry is to penetrate waterproof slabs, decks and walls, shall be of a type selected to suit the water condition encountered in the field.
- G. Existing cores and wall penetrations to be utilized for conduit routing where feasible.
- H. Provide oversized lugs or additional lugs where required to accommodate wire sizes indicated.

1.25 ACCESS DOORS GENERAL CONSTRUCTION

- A. Access doors are required for operation and maintenance of concealed equipment, valves, controls, etc., will be provided by this subcontractor and installed under another section of the work.
- B. This trade is responsible for access door location, size and its accessibility to the valves or equipment being served.
- C. Coordinate and prepare a location, size and function schedule of access doors required, and deliver to a representative of the installing section.
- D. Access doors shall be of ample size, minimum of 16" x 16". Type as specified under another Section 083113.

1.26 TOILET FIXTURE WIRING

- A. Extend low voltage wiring from transformer furnished by fixture manufacturer in $\frac{3}{4}$ "C to fixture electronic valve and sensor. Installation by this contractor per wiring diagrams and wire sizes from manufacturer.

1.27 FURNITURE PARTITION SYSTEM

- A. System furnished by manufacturer and installed by furniture system installer. This contractor is to connect to furniture partition system with flexible conduit whip at hard wire junction box and install system electrical components.

1.28 LIGHTING FIXTURES

- A. Where drawings indicate relocated fixtures or re-used fixtures the electrical contractor shall:
 - 1. Protect fixtures during construction.
 - 2. Relamp all existing fixtures to remain.
 - 3. Clean lenses.
 - 4. Inspect ballasts and lenses and provide written report on required ballast replacements for review by Engineer and Owner.
 - 5. Provide new lenses as specified on architectural drawings.
 - 6. Provide new 90-minute emergency ballasts on fixtures indicated.
- B. Contractor to coordinate and be responsible for dimmer compatibility with all specified fixtures.
- C. All fixtures to be lamped at completion of project.
- D. Furnish and install remote stepdown transformers, ballasts, drivers, and power supplies, (compatible with lighting fixture suitable for mounting in Plenum hung ceiling), that are provided with such accessories.
- E. Transformers, remote ballast, power supplies and led drivers must be thermal and sound rated for a hung ceiling, cove and wall cavity application.
- F. Transformers, drivers, power supply, and remote ballasts to be located in accessible ceiling areas and locations indicated on final as built plans. Prepare shop drawings for review and approval by Architect and Engineer for all transformer and ballast locations, with access door requirements.

1.29 PRE-CONSTRUCTION SURVEY

- A. Prior to start of construction, the electrical contractor shall trace out all existing conduit and wiring serving construction area and affected circuiting extending to adjacent areas and prepare as wired plan indicating circuits, panel identification, circuit number and equipment served. Submit to Owner and Engineer for review and approval prior to start of construction.
- B. Provide temporary branch circuiting to serve adjacent areas and critical circuits (which cannot be shutdown) as directed by Owner and Engineer. Connections to be done without disruption for service.

- C. Relocate affected circuits serving adjacent areas as required. Final number to be determined upon completion of as-wired plan.
- D. Combine existing underutilized circuits as required to make "spares" for new work. Determination of circuits to be combined to be based on as-wired plan after review by Engineer.

1.30 CONNECTIONS TO EXISTING WORK

- A. Provide pull boxes, junction boxes and conduit for extension of new work to existing.
- B. Provide new material and equipment required for relocated equipment.
- C. Install new work and connect to existing work with minimum interference to existing facilities.
- D. Temporary shutdowns of existing services shall be at no additional charges at time not to interfere with normal operation of existing facilities and only with written consent of Owner.
- E. Alarm and emergency systems not to be interrupted.
- F. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
- G. Connect new work to existing work in neat and acceptable manner, restore existing disturbed work to original condition including maintenance of wiring continuity as required.

1.31 EXIT AND EMERGENCY LIGHT SYSTEM

- A. All exit signs will be circuited to generator backed emergency only panels.
- B. All emergency egress path and stairwell fixtures will be circuited to generator backed emergency only panels.
- C. Provide locking clips for new and existing circuit breakers serving emergency only circuits and exit sign circuits.

1.32 ELECTRICAL DEMOLITION NOTES

- A. With the exception of life safety systems, all existing lighting fixtures, branch circuits, conduit, wiring, backboxes and devices within walls are to be disconnected and removed from the site. See architectural plans for extent of demolition. All wiring to be removed back to respective circuit breakers. Existing circuit breakers in panelboards to remain shall be replaced. No wiring (power, low voltage, etc.) shall be left abandoned.

- B. Provide temporary lighting in work area. Provide new branch circuits from existing panelboards as required to maintain continuity of lighting.
- C. Tag and trace all existing circuits which serve adjacent occupied spaces. Label all circuits and maintain continuity as required.
- D. Contractor shall field survey and be familiarized with existing conditions prior to bid submission.
- E. Refer to construction documentation from all other trades for other demolition requirements and coordinate with trades accordingly.
- F. Remove all temporary feeders and electrical devices used for lighting, heating, securing space, etc.
- G. Provide temporary power, as required, for all 'existing to remain' circuits during the course of demolition. Restore permanent power upon completion of demolition phase.
- H. Existing fire alarm system to remain in operation throughout demolition and construction. Do not remove any existing fire alarm devices.
- I. All telephone cable, strip cabinets, AV and computer cables to be removed from the site by the IT contractor.
- J. Remove all ceiling light fixtures, conduit, junction boxes, switches, and all interconnecting conduit back to electrical panels.
- K. All life safety wiring and panels, including speakers, alarms and emergency lights, are to remain as installed and operating. Provide temporary supports as required. Demolish after new devices are installed and operational.
- L. All work requiring power outage which affects building common areas, risers, adjacent occupied spaces, other floors, etc., shall be done on overtime and work shall be continuous until power is restored.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 26 Specification Sections, apply to this and other sections of Division 21.
- B. Vibration and wind criteria for this section is referenced in specification Section 230548. Vendor/manufacturer/contractor is responsible for this Section 230548 in its entirety.
- C. Construction and Demolition Waste Management

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

- A. EPDM: Ethylene-Propylene-Diene Terpolymer Rubber.
- B. NBR: Acrylonitrile-Butadiene Rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.

- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
 - 6. AFC Cable System, Inc.

- C. Copper Conductors: Comply with NEMA WC 70. Aluminum conductors will not be permitted.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THW THHN-THWN XHHW.
- E. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with solid insulated ground wire.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 METAL CLAD CABLE ("MC")

- A. Manufacturers: Subject to compliance with requirements, provide products by:
 - 1. General Cable.
 - 2. Triangle.
 - 3. AFC.
 - 4. National Electric Product.
- B. Description:
 - 1. It shall be an industry standard, factory fabricated assembly of insulated 98% conductivity soft drawn copper conductors and a flexible metallic covering of interlocked galvanized steel or aluminum armored tape.
 - 2. Cable to be provided with an insulated equipment ground conductor.

2.4 FIRE RATED METAL CLAD CABLE ("MC")

- A. Manufacturers: Subject to compliance with requirements, provide products by:

Low Voltage Electrical Power Conductors and Cables

1. Raychem.
2. VITALink.

B. Description:

1. 2 hour fire rated cable with copper sheath armor that meets NEC requirement for equipment grounding conductor.

2.5 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe", equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

2.6 SLEEVE SEALS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2 and THWN-2, single conductors in raceway.
- C. Fire Pump, Special Service Fire Pump: Concrete Encased or rigid metal conduit in enclosed shaft.
- D. Emergency Feeders not in rated enclosure: Concrete encased.
- E. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2 and THWN-2, single conductors in raceway.
- F. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN-2, single conductors in raceway.
- G. Feeders Installed below Raised Flooring: Type THHN-2 and THWN-2, single conductors in raceway.
- H. Feeders in Cable Tray: Type THHN-2 and THWN-2, single conductors in raceway.
- I. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN-2, single conductors in raceway.
- J. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.
- K. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN-2, single conductors in raceway.
- L. Branch Circuits Installed Below Raised Flooring: Type THHN-2 and THWN-2, single conductors in raceway.

- M. Branch Circuits in Cable Tray: Type THHN-2 and THWN-2, single conductors in raceway.
- N. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh strain relief device at terminations to suit application.
- O. Class 1 Control Circuits: Type THHN-2 and THWN-2, in raceway.
- P. Class 2 Control Circuits: Type THHN-2 and THWN-2, in raceway.
- Q. Generator control wiring to automatic transfer switches/fire pump controller — in rated enclosure or concrete encased.
- R. Branch Circuits and Feeders installed in wet locations as noted on drawings: Type THHN-THWN-2, single conductors in raceway.
- S. Branch Circuits and Feeders installed in conduit exposed to direct sunlight on or above rooftops: Type XHHW-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems".
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems".
- G. All branch circuits to be provided with minimum three wires (Neutral, Hot and insulated ground wire), no sharing of neutrals will be permitted. Ground can be shared for general convenience circuits only.
- H. Calculate pulling tension and sidewall pressure where requested.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052-inch.
 - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138-inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants".
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping".
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping".

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 26 Specification Sections, apply to this and other sections of Division 21.

1.2 SUMMARY

- A. Section Includes: Grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For qualified testing agency and testing agency's field supervisor.
- D. Field quality-control reports.
- E. Grounding riser diagram - diagram indicating how grounding system will be installed. Indicate equipment being grounded, wire sizes, and conduit sizes.
- F. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 26 Section "Operation and Maintenance Data," include the following:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems in computer room areas based on NETA MTS NFPA 70B.

- a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member Company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, and 1/4-inch in diameter.
 - 5. Bonding Conductor: See drawings for size or as required by code.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16-inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16-inch thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
 - 1. See drawings for size or as required by code.
 - 2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.
 - 3. Copper.
- D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; see drawings for sizes or as required by code.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.

2.4 GROUND BARS

- A. Copper with double holes on standoff insulators 1/4-inch thick.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Conductors to be provided with permanent green-colored insulation with continuous yellow stripe.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, if required by Avizt Consultants drawings/specifications or the documents provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
 1. For telephone, alarm, voice and data, and other communication equipment, provide insulated grounding conductor in raceway from grounding electrode system to each service location, as sized on plans or as required by technology consultant, terminal cabinet, wiring closet, and central equipment location.
 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus or as sized on plans.
 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches above finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is

- installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches from building's foundation.
- 3.4 LABELING
- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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 and other sections of Division 21.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Mineral-Insulated Cable" that indicates specific requirements for support of MI Cable.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

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- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 4. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

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- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 HANGING REQUIREMENTS

- A. The minimum size of anchors shall be 3/8 inch. Power and powder actuated fasteners will not be permitted. The intention is to provide support which, in each case, shall be amply strong and rigid for the load, but which shall not weaken or unduly stress the building construction.

3.2 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.3 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.4 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.5 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

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 and other sections of Division 21.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.

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2. For handholes and boxes for underground wiring, including the following:
 - a. Duct entry provisions, including locations and duct sizes.
 - b. Frame and cover design.
 - c. Grounding details.
 - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - e. Joint details.
 - C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Structural members in the paths of conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
 - D. Qualification Data: For professional engineer and testing agency.
 - E. Source quality-control test reports.
- 1.5 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AFC Cable Systems, Inc.
 2. Alflex Inc.
 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. Electri-Flex Co.
 6. Manhattan/CDT/Cole-Flex.
 7. Maverick Tube Corporation.
 8. O-Z Gedney; a unit of General Signal.

- 9. Wheatland Tube Company.
- C. Rigid Steel Conduit: ANSI C80.1.
- D. Aluminum Rigid Conduit: ANSI C80.5.
- E. IMC: ANSI C80.6.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
 - 3. Schedule to type.
- G. EMT: ANSI C80.3.
- H. FMC: Zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel, compression type.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- K. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.; Pipe & Plastics Group.
 - 6. Condux International, Inc.

7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

- C. ENT: NEMA TC 13.
- D. RNC: NEMA TC 2, Type EPC-80-PVC, unless otherwise indicated.
- E. LFNC: UL 1660.
- F. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- G. Fittings for LFNC: UL 514B.
- H.

2.3 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Square D; Schneider Electric.
- C. Description: Sheet metal sized and shaped as indicated on drawings, NEMA 250, Type 1 and 3R, unless otherwise indicated.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: Hinged type As indicated.
- F. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Surface Metal Raceways: Metal with snap-on covers and separation of low and line voltage wiring. Custom finish in color selected by Architect.

1. Aluminum Raceway
 - a. Basis-of-Design:
 - 1) Wiremold Company Model ALA 4800 series
 - b. Acceptable Alternatives:
 - 1) Subject to compliance with requirements. Provide products that are equivalent in type, size, material and performance to basis of design.
2. Steel Raceway
 - a. Basis of Design
 - 1) Wiremold 4000 Series
 - b. Acceptable Alternatives:
 - 1) Subject to compliance with requirements. Provide products that are equivalent in type, size, material and performance to basis-of-design.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 2. EGS/Appleton Electric.
 3. Erickson Electrical Equipment Company.
 4. Hoffman.
 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 6. O-Z/Gedney; a unit of General Signal.
 7. RACO; a Hubbell Company.
 8. Robroy Industries, Inc.; Enclosure Division.
 9. Scott Fetzer Co.; Adalet Division.
 10. Spring City Electrical Manufacturing Company.
 11. Thomas & Betts Corporation.
 12. Walker Systems, Inc.; Wiremold Company (The).
 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

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- D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- F. Metal Floor Boxes: Cast metal or sheet metal, fully adjustable, rectangular.
- G. Nonmetallic Floor Boxes: Nonadjustable, round.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.
- J. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
- K. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by a independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: RNC, Type EPC- 80-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Kitchens.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: Rigid steel conduit.
 7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway EMT.
 8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway EMT.
 9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp, wet locations, or exposed in kitchens.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT or RNC, Type EPC-80-PVC to rigid steel conduit, or IMC before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

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- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature changes.
 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- O. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- Q. Set metal floor boxes level and flush with finished floor surface.

- R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- S. Install nylon bushings at ends of conduits for AV, IT, and security.
- T. Where conduit passes through on seismic/structural joint, provide suitable expansion fitting.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. Trench width to be a minimum of conduit bank width and an additional 6 inches on each side.
4. Conduits can only be routed on top of each other at intersection points. Conduits being routed in same direction to be level with adjacent conduits. Multiple rows of parallel conduits are not permitted.
5. Secure conduit to bottom of trench. Provide uni-strut cross bracing on top of conduit bank to restrict movement. Support/bracing to be spaced in accordance with code.
6. Provide expansion fittings for PVC piping to compensate for thermal expansion and contraction.
7. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
8. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
10. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.
 - a. Pressure-Treated Wood Plank: 2 inches x 12 inches.

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11. Install metal warning tape on top of wood plank.
12. Where conduit passes through a seismic/structural joint provide suitable expansion fitting.
13. Provide metal elbows for all direction changes of PVC conduits.
14. Provide equipment ground conductors sized in accordance with code for all underground conduit.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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SECTION 260544 - SLEEVES FOR RACEWAYS AND CABLES

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 and other sections of Division 21.
- B. Vibration, seismic, wind & flood criteria for this section is referenced in specification section 230548. Vendor/manufacturer/contractor is responsible for this and section 230548 in its entirety.

1.2 SUMMARY

A. Section Includes:

- 1. Electrical equipment coordination and installation.
- 2. Sleeves for raceways and cables.
- 3. Sleeve seals.
- 4. Grout.
- 5. Common electrical installation requirements.
- 6. Silicone sealants.

B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

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1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope so connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 078413 "Penetration Firestopping".

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

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2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials, Inc.
 - c. Polymeric Systems, Inc.
 - d. Schnee-Morehead, Inc., an ITW Company.
 - e. Sherwin-Williams Company (The).
 - 2. Sealant shall have VOC content of 250 g/L or less.

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3. Sealant shall comply with the testing and product requirements of the California Department of Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
 2. Sealant shall have a VOC content of 250 g/L or less.
 3. Sealant shall comply with the California Department of Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Smooth-On.
 2. Sealant shall have a VOC content of 250 g/L or less.
- D. Sealant shall comply with the California Department of Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

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- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. See drawings for sleeve lengths required. If sleeve lengths are not indicated extend sleeves between required walls/floors a minimum of 2 inches past each side of wall/floor.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable

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penetration sleeves with firestop materials. Comply with requirements in Section 078413 "Penetration Firestopping."

- L. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.
- O. For all rooms indicated to be provided with power, AV, IT, or security to be provided with full height walls, provide metal sleeves between room and circulation space, size and quantity of sleeves are to provide a maximum of a 60% fill, each type of circuitry, power, AV, IT, security, must be separated.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

END OF SECTION 260544

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SECTION 260548

VIBRATION ISOLATION, & WIND LOAD RESTRAINTS FOR HVAC, PLUMBING & ELECTRICAL COMPONENTS

SECTION 1 – GENERAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections apply to this Section
- B. This section specifies required vibration control for all equipment, where applicable, with the wind load requirements for all equipment in outdoor locations. When projects are located in a geographically active wind location, Section 1.4, General Design and Performance Requirements, will elaborate on those requirements and include specifics pertaining to a facility's "continued operation." Para. 1.2, Section D is a partial list of components covered herein. This specification is part of the general conditions for the HVAC, Plumbing, Electrical and Fire Protection contracts.

1.2 SUMMARY

- A. This section includes the following:
 - 1. All equipment, piping, ductwork and conduit as noted on the drawing's schedule or in the specification shall be seismically braced if the building is so classified as listed herein. Vibration control shall apply as described in all cases herein.
 - 2. All outdoor equipment, including roof-mounted components, shall comply with section 1609, Wind Load, IBC-2006. There shall be no decrease of the effects of wind load on a component due to other structures or components acting as blocks or screens.
 - 3. Wind and isolation materials shall be the certified products of the same manufacturing group and shall be certified by that group.
 - 4. It is the intent of the wind load portion of this specification to keep all mechanical, electrical, plumbing and fire protection building system components in place during a seismic or high wind event and additionally operational where the occupancy category of the building so requires as listed herein.
 - 5. All such systems must be installed in strict accordance with wind codes, component manufacturer's and building construction standards.
 - 6. This specification is considered to be minimum requirements for wind and vibration control considerations.

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7. Any variation, which results in non-compliance with the specification requirements, shall be corrected by the contractor in an approved manner.
- B. The work in this section includes, but is not limited to, the following:
1. Vibration isolation for piping, ductwork, bus duct, cable tray conduit and equipment, all referred to as components.
 2. Component isolation bases.
 3. Wind restraints for isolated components.
 4. Wind restraints for non-isolated components.
 5. Certification of wind restraint designs.
 6. Installation supervision.
 7. Design of attachment of housekeeping pads.
 8. All components requiring IBC compliance and certification.
 9. All inspection and test procedures for components requiring IBC compliance.
- C. All mechanical, electrical, plumbing or fire protection equipment, pipe and ductwork, within, on or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.
- D. Components referred to below are typical. (Components not listed are still included in this specification.) All systems that are part of the building in any way are referred to as components, including:
- | | |
|-------------------------|-------------------------|
| ▪ AC Units Adapter Curb | ▪ Ductwork |
| ▪ Air Handling Units | ▪ Electrical Panels |
| ▪ Air Separators | ▪ Equipment Supports |
| ▪ Battery Chargers | ▪ Fans (all types) |
| ▪ Battery Racks | ▪ Fan Coil Units |
| ▪ Boilers | ▪ Fire Alarm Panels |
| ▪ Bus Ducts | ▪ Gas Detection Systems |
| ▪ Cabinet Unit Heaters | ▪ Generators |
| ▪ Cable Trays | ▪ Heat Exchangers |
| ▪ Chillers | ▪ Humidifiers |
| ▪ Compressor | ▪ Light Fixtures |
| ▪ Computer Room Units | ▪ Motor Control Centers |
| ▪ Condensing Units | ▪ Pipe |
| ▪ Cooling Towers | ▪ Pumps (all types) |
| ▪ Curbs | ▪ Risers |
| ▪ Dry Coolers | ▪ Rooftop Units |

- Supports
- Switch Gear
- Tanks (all types)
- Transformers
- Unit Heaters
- Unit Substations
- Unit Ventilators
- Variable Frequency Drives
 - VAV Boxes
 - Vibration Isolators
- Water Heaters

1.3 DEFINITIONS (building and components, all codes)

A. ESSENTIAL FACILITIES, (Occupancy Category, IBC-2006)

1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

B. GENERAL

Anchor: A device, such as an expansion bolt, for connecting equipment bracing members to the structure of a building.

Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing analytical or inspection services, when such agency has been approved.

Attachment: See Positive Attachment below.

Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per Section 1609 (IBC-2006), or local code, if more severe. Local jurisdictions shall determine wind speeds for indicated special wind regions located near gorges or mountainous terrain. Section 6.5.4 of ASCE 7-05 shall be used after determination of basic wind speed by the local jurisdiction. See Section 1609.3 ASCE 7-05 for basic wind speed determination in non-hurricane prone regions.

Bracing: Metal channels, cables or hanger angles that prevent components from breaking away from the structure during an earthquake or high winds. See also Longitudinal Bracing and Transverse Bracing. Together, they resist environmental loads from any direction.

Certificate of Compliance: A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents, provided by an approved agency. (Certificate to be supplied by equipment component manufacturer.)

Component: A non-structural part or element of an architectural, electrical, mechanical, plumbing or fire protection system within or without of a building system.

Component Importance Factor: Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5.

Component, flexible: Component, including its attachments, having a fundamental period greater than 0.06 seconds.

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Component, rigid: Component, including its attachments, having a fundamental period less than or equal to 0.06 seconds.

Consequential Damage: The functional and physical interrelationship of components, their supports and their effect on each other shall be considered so that the failure of an essential or non-essential architectural, mechanical or electrical component shall not cause the failure of an essential architectural, mechanical or electrical component.

Equipment: Systems associated with ducts, pipes and conduits also called components.

Flood or Flooding: A general and temporary condition or partial and complete inundation of normally dry land from:

1. The overflow of inland or tidal waters.
2. The unusual and rapid accumulation of runoff of surface waters from any source.

Flood Hazard Area: The greater of the following of two areas:

1. The area within a flood plain subject to a 1 percent or greater chance of flooding in any year.
2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

Special Flood Hazard Area Subject to High Velocity Wave Action: Area within the flood hazard area that is subject to high velocity wave action and shown on a Flood Insurance Rate Map (FIRM) or other flood hazard map as zone V, VO, VE or VI-30.

Flood Insurance Rate Map (FIRM): An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

Gas pipes: For the purposes of this Specification Guide, gas pipe is any pipe that carries fuel, gas, fuel oil, medical gas, or compressed air.

Hazardous Contents: A material that is highly toxic or potentially explosive or corrosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.

Hurricane Prone Regions: Areas prone to hurricanes include the U.S. Atlantic Ocean, Gulf Coasts, Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa where the wind speed is greater than 90 mph.

Importance Factor, I: A factor that accounts for the degree of hazard to human life and damage to property.

Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and

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identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency (*see Section 1703.5 and "Label" and "Manufacturer's Designation" and "Mark"*).

Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency (*see Section 1703.5 and "Inspection Certificate," "Manufacturer's Designation" and "Mark"*).

Lateral forces: A force acting on a component in the horizontal plane. This force can be in any direction.

Longitudinal bracing: Bracing that prevents a component from moving in the direction of its run.

Longitudinal force: An applied force that happens to be in the same direction as the duct or pipe run.

Mark: An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (*see also "Inspection Certificate," "Label" and "Manufacturer's Designation"*).

Manufacturer's Designation: An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules (*see also "Inspection Certificate," "Label" and "Mark"*).

Occupancy Category: A classification used to determine structural load requirements including those imposed by wind, flood, snow and seismic based on occupancy of the structure.

Positive Attachment: A mechanical device, designed to resist seismic forces, which connects a non-structural element, such as a duct, to a structural element, such as a beam. Bolts and welding are examples of positive attachments. Surface glue and friction anchorage do not constitute positive attachment. Examples of positive attachment are epoxy cast in anchors and drill in wedge shaped anchor bolts to concrete and welded or bolted connections directly to the building structure. Double-sided beam clamps, C type are not acceptable as either brace point attachments to the structure or for the support of the component at the bracing location.

Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in Table 1613.5.2 (IBC-2006).

Special Inspection: Inspection as herein required of the materials, installation, fabrication, erection or placement of components and connections requiring special documents and referenced standards (*see Section 1704, IBC-2006*).

Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or

is being performed and at the completion of the work.

Story Drift Ratio: The story drift (Lateral displacement) divided by the story height.

Wind-Borne Debris Region: Portions of hurricane-prone regions that are within 1 mile of the coastal mean high water line where the basic wind speed is 110 mph or greater, or portions of hurricane-prone regions where the basic wind speed is 120 mph or greater; or Hawaii.

1.4 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

A. General Design Requirements

1. SEISMIC CONSIDERATIONS: This project has seismic design requirements as follows:
NONE
2. WIND CONSIDERATIONS: This project has wind design requirements as follows:

B. General Design Performance Requirements

1. Design Wind Loads:
 - a. All outdoor mounted components shall be positively fastened to their supporting structure as discussed below. Fastening to metal deck is unacceptable.
 - 1) If component is curb mounted, para 2 in this section shall be followed for all roof-mounted components in excess of 9 sq. ft. in cross-sectional area. Curbs shall be as described in Base type B-3 if isolated, Base type B-4 if non-isolated.
 - 2) If component is support mounted, para 2 in this section shall be followed for all roof-mounted components requiring waterproofed rail supports. Equipment supports shall be Base type B-5 if isolated, Base type B-6 if non-isolated.
 - 3) If equipment is dunnage mounted, positive attachment shall occur through welding or bolting of equipment to dunnage steel.
 - b. Loads and calculations shall be based on IBC-2006, figure 1609 and related sections in ASCE 7-05.
 - c. Where buildings are less than or equal to 60 feet in height to the top of the roof slab (not parapet walls), *the force on* roof-mounted components shall be based on Section 6.5.15.1, ASCE 7-05.
 - d. Equivalent basic wind speed shall be based on IBC-2006, Table 1609.3.1.
 - e. In no event shall adjacent buildings, structures or screens be considered to diminish the calculated wind load or its effect on an outdoor component.
2. Whether the equipment is internally or externally isolated and restrained, the entire unit assembly must be seismically attached to the structure. Curb or roof rail mounted equipment must not only have seismic or wind attachment of the equipment to the roof but also to the curb or rails. The attachment and certification thereof shall be by this

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section. Sheet metal screw attachment is acceptable provided that the following five conditions are met and verified.

- a. Calculations support sufficient quantity and size of sheet metal screws to handle all loads including shear.
- b. Shear and tension allowables are obtained from an accredited third party source, such as ICC or NDS, not from the screw manufacturer.
- c. Space or gap between the inside overhang of the rooftop unit and the curb at each of the screw locations is closed with structural material, tapered to contour to both the curb and the components' inside edge structure.
- d. Attachment points of the roof-mounted unit to curb and the curb to structure demonstrates structural load path.
- e. The method of attachment does not violate the NRCA rating of the curb by violating the roof member's waterproofing.

1.5 SUBMITTALS

- A. Refer to Part 1, General.
- B. Product Data: The manufacturer of vibration isolation, wind restraints shall provide submittals for products as follows:
 1. Descriptive Data:
 - a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
 - b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and restraints by referencing numbered descriptive drawings.
 2. Shop Drawings:
 - a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
 - b. Provide all details of suspension and support for ceiling hung equipment.
 - c. Provide specific details of restraints and anchors, include number, size and locations for each piece of equipment. Restraint and anchor allowables shall be by structural testing, shake testing, analysis or third party certification.
 - d. Calculations shall be submitted as required in Section 1.4, General Design and Performance Requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer of vibration isolation and wind load control equipment or manufacturer's approved representative shall have the following responsibilities:
 1. Determine vibration isolation and restraint sizes and locations.
 2. Provide vibration isolation and restraints as scheduled or specified.
 3. Provide calculations and materials, if required, for restraint of non-isolated equipment.
 4. Provide installation instructions in writing, drawings and trained field supervision, where

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necessary, to insure proper installation and performance.

5. Certify correctness of installation upon completion, in writing.
 6. All provisions of Section 1.4, General Design and Performance Requirements.
- B. All manufacturers of vibration control, wind or flood restraining systems must provide a Design Error and Omissions Insurance Certificate for their firm or their design consultant to certify their ability to provide engineering and design as required by this section. This document shall be provided at the time of first submittal from the restraint provider.
- C. All manufacturers of any type of equipment including OEM are responsible for Section 1.5.
- D. Equipment manufacturer's substitution of internally or externally isolated and/or restrained equipment supplied by the equipment vendor, in lieu of the isolation and restraints specified in this section, is acceptable provided all conditions of this section are met.
- E. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the component vendor in the event of non-compliance with the preceding. Substitution of internal isolation is unacceptable for:
1. Indoor or outdoor mounted equipment over or adjacent to:
 - a. Guest Rooms
 - b. Retail or Public Spaces
 - c. Office locations

1.7 RELATED WORK

- A. Housekeeping pad structural design, including its attachment to building structure, shall be by the structural engineer of record or as shown on the contract drawings. Attachment of all components and restraints to the pad and size of the pad shall be designed and certified according to this section by the seismic/isolation supplier. Material and labor required for attachment and construction shall be by the concrete section contractor, or by the contractor where specified. Housekeeping pads shall be sized to accommodate a minimum 6" of clearance all around the equipment; or 12 times the outermost anchor bolt diameter, whichever is greater. Where exterior isolators are used, this distance shall be as measured from the outermost holes in the isolator base plate to the edge of the housekeeping pad.
- B. The project's structural engineer shall design all roof and interior steel to support and make connections to all components, including roof-mounted equipment specified in other sections. Design shall comply with IBC requirements including load path to structure.
- C. Roof steel supporting roof-mounted equipment shall be designed for all wind forces including, but not limited to, tension, compression and moment loads.

- D. Chimneys, stacks and boiler breeching passing through floors are to be attached at each floor level with a riser guide.

1.8 CODE AND STANDARDS REQUIREMENTS

1. Typical Applicable Codes and Standards

a. All City, State and Local Codes (Code)

- 1) American Society For Testing and Materials (ASTM) (Standard)
 - 2) International Conference of Building Officials (ICBO) (Standard)
 - 3) International Building Code (Code)
 - 4) ASHRAE (Standard reference, to be used for design purposes only, not code).
 - 5) VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association) (Standard reference, to be used for design purposes only, not code).
2. In cases where requirements vary, the guideline for the most stringent shall be utilized.
 3. International Fire Code
 4. Use IBC-2006 as reference code standard unless otherwise designated.

PART 2 – PRODUCTS

2.1 DESCRIPTION

- A. All vibration isolators and seismic restraints described in this Section shall be the product of a single manufacturer. The basis of this specification is The VMC Group, including Vibration Mountings & Controls, Amber/Booth or Korfund Dynamics. Products from other nationally recognized manufacturers are acceptable provided their systems strictly comply with these specifications and have the approval of the specifying engineer. Manufacturer shall be a regular member of VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association). See Form VL-1 listing other manufacturers to be considered for use on this project.

2.2 VIBRATION ISOLATION TYPES

A. Type A: Spring Isolator – Free Standing

A*

1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded elastomeric cup or 1/4" elastomeric acoustical friction pad between the bottom of isolator and the support.
2. All mountings shall have leveling bolts that must be rigidly bolted to the equipment.

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3. Spring diameters shall be no less than 0.8" of the compressed height of the spring at rated load.
 4. Springs shall have a minimum additional travel to solid equal to 50% of the operating deflection.
- B. Type B: Wind Restrained Spring Isolator
MS, MSS, AEQM, ASCM, AMSR
1. Restrained spring mountings shall have a Type A spring isolator within a rigid housing that includes vertical limit stops to prevent spring extension if weight is removed. The housing shall serve as blocking during erection. A maximum clearance of ¼" shall be maintained around restraining bolts and internal elastomeric deceleration bushings. Limit stops shall be out of contact during normal operation. If housings are to be bolted or welded in position there must be an internal isolation pad or elastomeric cup. Housing shall be designed to resist all seismic forces.
- C. Type C: Combination Spring/Elastomer Hanger Isolator (30° Type)
HRSA
1. Hangers shall consist of rigid steel frames containing minimum 1 ¼" thick elastomeric elements at the top and a steel spring with general characteristics as in Type A. The elastomeric element shall have resilient bushings projecting through the steel box.
 2. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the rod bushing and short-circuiting the spring.
 3. Submittals shall include a hanger drawing showing the 30° capability.
 4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.
- D. Type D: Elastomer Double Deflection Hanger Isolator
HR
1. Molded (minimum 1 ¼" thick) elastomeric element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be a minimum of 0.35."
 2. Steel retainer box encasing elastomeric mounting capable of supporting equipment up to two times the rated capacity of the element.
- E. Type E: Combination Spring/Elastomer Hanger Isolator
HRS
1. Spring and elastomeric elements in a steel retainer box with the features as described for Type C and D isolators.
 2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be

type pre-compressed or pre-positioning for all manufacturers.

3. 30° angularity feature is not required.

F. Type F: Wind Restrained Elastomer Floor Isolator
RSM, MB, RUD

1. Bridge-bearing elastomeric mountings shall have a minimum static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron or aluminum casting containing molded elastomeric elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock-absorbing elastomeric materials shall be compounded to bridge-bearing or Durulene™ specifications.

G. Type G: Pad Type Elastomer Isolator (Standard)
Maxiflex

1. One layer of ¾" thick elastomeric pad consisting of 2" square modules for size required.
2. Load distribution plates shall be used as required.
3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

H. Type H: Pad Type Elastomer Isolator (High Density)
Fabri-Flex, NDB, NRC

1. Laminated canvas duck and neoprene, maximum loading 1000 psi, minimum ½" thick.
2. Load distribution plate shall be used as required.
3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

I. Type I: Thrust Restraints
RSHTR, TRK

1. A spring element similar to Type A isolator shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to ¼" due to thrust forces. Contractor shall supply hardware.
2. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.

J. Type J: Pipe Anchors
MDPA, AG

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1. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing or piping separated by a minimum ½" thick 60 durometer elastomer.
2. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction.
3. Applied loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.

K. Type K: Pipe Guides
PG/AG/SWP/SWX

1. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing or piping separated by a minimum ½" thickness of 60 durometer elastomer.
2. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and replaceable to allow for selection of pipe movement.
3. Guides shall be capable of ± 1 5/8" motion, or to meet location requirements.

L. Type L: Isolated Pipe Hanger System
CIH, CIR, TIH, PIH

1. Pre-compressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.
2. Spring element (same as Type A) with steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate support rod from the isolation hanger.
3. The elastomeric element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.
4. Hangers shall be designed and constructed to support loads over three times the rated load without failure.
5. Systems shall be pre-compressed to allow for rod insertion and standard leveling.

2.3 WIND RESTRAINT TYPES

A. Type I: Spring Isolator, Restrained
MS, MSS, AEQM, ASCM, AMRS

1. Refer to vibration isolation Type B.

B. Type II: Wind Restrained Elastomer Floor Isolator
MB, RUD

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1. Refer to vibration isolation Type F.

C. Type III: All-Directional Wind Snubber
SR, ER

1. All-directional snubbers shall consist of interlocking steel members restrained by an elastomeric bushing. Bushing shall be replaceable and a minimum of 1/4" thick. Applied loading shall not exceed 1000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Elastomeric bushings shall be rotated to insure no short circuits exist before systems are activated.

D. Type IV: Floor or Roof Anchorage
Cast-In Plates

1. Rigid attachment to structure utilizing wedge type anchor bolts, anchored plates, machine screw, bolting or welding. Power shots are unacceptable.

2.4 EQUIPMENT BASES

A. General

1. All curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck (minimum thickness shall be 4") for resisting wind and seismic forces in accordance with the project location. (Fastening to metal deck is unacceptable.)

B. Base Types

1. Type B-1: Integral Structural Steel Base
WFB, SFB, WSB
 - a. Rectangular bases are preferred for all equipment.
 - b. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case and end suction pumps shall include supports for suction and discharge elbows.
 - c. All perimeter members shall be structural steel beams with a minimum depth equal to 1/12 of the longest dimension between isolators.
 - d. Base depth need not exceed 12" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
 - e. Height saving brackets shall be employed in all mounting locations to provide a minimum base clearance of 2."
2. Type B-2: Concrete Inertia Base

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MPF, WPF, CPF

- a. Vibration isolation manufacturer shall furnish rectangular welded or bolted modular steel concrete pouring forms for floating and inertia foundations.
 - b. Bases for split case and end suction pumps shall be large enough to provide for suction and discharge elbows.
 - c. Bases shall be a minimum of 1/12 of the longest dimension between isolators but not less than 6.”
 - d. The base depth need not exceed 12” unless specifically recommended by the base manufacturer for mass or rigidity.
 - e. Forms shall include a minimum concrete reinforcing consisting of 3/8” bars welded in place a maximum of 16” on centers running both ways in a layer 1 to 1½” above the bottom.
 - f. Forms shall be furnished with steel templates to hold the component anchor bolts sleeves and anchors while concrete is being poured.
 - g. Height saving brackets shall be employed in all mounting locations to maintain a 2” minimum operational clearance below the base.
3. Type B-3: Wind Load Isolation Curb
P6200, P6300

Option: Sound Package 1 & 2 VMC/AB-RPFMA/SRPFMA

- a. Curb-mounted rooftop equipment shown on isolation schedule shall be mounted on structural wind restrained spring isolation curbs. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind load forces. The lower frame must accept point support for both wind load attachment and leveling. The upper frame must be designed with positive fastening provisions (welding or bolting), to anchor the rooftop unit to the curb, which will not violate the National Roofing Contractors Association (NRCA) ratings of the membrane waterproofing. Sheet metal screws are only acceptable if all provisions in Section 1.4, Article B, paragraph 7, Design Wind Loads, are met. Contact points between the rooftop unit, the curb and the building’s structure shall show load path through those locations only.
- b. All-directional elastomeric snubber bushings shall be minimum of ¼” thick. Steel springs shall be laterally stable and rest on ¼” thick elastomeric acoustical pads or cups.
- c. Hardware must be plated and the springs shall be powder-coated or cadmium-plated.
- d. The curb’s waterproofing shall be designed to meet all NRCA requirements.

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- e. All spring locations shall have full spring view access ports with removable waterproof covers and all isolators shall be adjustable, removable and interchangeable.
- e. Isolated curbs shall be supplied with a continuous air seal between the upper floating member and the stationary wood nailer.

Option #1 Where sound barrier package is required, curb shall have full size lay in attenuation panels having a minimum STC rating of 60 when combined with the roof deck's rating. Attenuation system shall add a full sound attenuation structural floor to the curb capable of spanning the curb's width and designed for live loads of 20 psf. Panels shall not weigh more than 6 psf. The 4" nominal galvanized panel shall be joined to allow for airtight construction and additionally shall have a support system where the panels are used below an outside condenser section. Panels shall be waterproof for both outdoor and indoor application. The space below the curb panels and the roof deck shall have 4" of insulation contractor furnished and installed.

Curb wall construction shall utilize the roofer's standard insulation where curbs use the TAS open thermal acoustical screening system. Solid wall curbs shall use 2" of the factory duct liner installed by the curb manufacturer. The entire curb shall have a continuous neoprene elastomeric air seal. Type RPFMA shall use an open return system with the roof return opening set as far as possible from the unit's return opening.

Option # 2 When curb type SRPFMA (Supply Return Plenum Construction) is required, in addition to Option # 1 the walls of the supply section will use 2" sound attenuating panels as well as a continuous inner elastomeric air seal and isolated plenum divider. Both supply and return ducts shall seal directly to curb base floor attenuation panels.

4. Type B-4: Wind Load Non-Isolated Curbs
P6000

Option: Sound Package VMC-RPFMA/SRPFMA System

- a. Wind load curbs shall have all provisions as Type B-3 curbs with the exception of spring isolation.
- b. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design wind loads.

5. Type B-5: Isolated Equipment Supports
R7200/R7300

- a. Continuous structural equipment support rails that combine equipment support and isolation mounting into one unitized roof flashed assembly with all features as described for Type B-3.

- b. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design wind loads.
6. Type B-6: Non-Isolated Equipment Supports
R7000
 - a. This shall have the same provisions as Type B-5 without the spring isolation.
7. Type B-7: Computer Room Unit Base
SFS
 - a. Computer Room air conditioning units shall be welded or bolted to welded structural steel stands having a minimum 0.5 "G" certified lateral acceleration capabilities, but no less than the design overturning loads.
 - b. Elastomeric isolated stands shall have 1" of adjustment to accommodate floor irregularities and 0.25" of nominal static deflection.
 - c. Spring isolated stands shall have 1" of adjustment to accommodate floor irregularities and 2" of nominal static deflection.
 - d. Bolting or welding is required to meet overturning criteria.
 - e. Stands to have positive fastening provisions for bolting of computer room unit to structural floor stand and fastening of floor stand to structure, capable of carrying the design overturning loads.
8. Type B-8 AHU / AC unit Structural Base Frames
 - a. Where roof mounted Air Conditioning or Air Handling Units are placed on steel platforms and are incapable of being point loaded or supported, structural frames shall be furnished which will either match the centerline dimensions of the unit's base frame rail or its curb dimensions. The structural frame shall have provisions to be welded or bolted to the unit's base frame and shall be supported on type "B" wind restrained isolation system.
 - b. Isolator deflection shall be either 1.5" or 2.5" depending on the tonnage of the roof mounted component as shown in Isolation Table "A". Structural Base Frame shall be type RTSBF as manufactured by The VMC Group.
9. Type B-9: Structural Adapter Curbs
 - a. Structural Adapter Curbs will be designed to match the replacement unit's curb dimensions to the existing unit's curb dimensions, matching both supply and return air delivery systems of both components or creating a plenum to accommodate airflow of both components.

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- b. The new adapter curb will be structurally designed to rest on the existing curb only and carry the new unit's load directly to building steel or concrete thru stanchions that are welded or bolted to both within the confines of the existing curb. Additionally, the new roof mounted unit will be welded or bolted to the structural adapter and shall demonstrate load path of all loads from all components into the building structure.
 - c. Where the installed unit component's height to the unit's electrical disconnect box is in excess of 78", a service platform or other suitable staging shall be utilized.
 - d. Structural Adapter Curbs shall be Type PSAC-6000 as manufactured by The VMC Group.
10. Type B-10 Structural Isolated Adapter Curbs:
- a. Where isolation is required to be incorporated into the adapter curb, isolation and restraining system shall be similar to the requirements highlighted under Base Type B-3. Isolator deflection shall be either 2" or 3" deflection as required by Isolation Table "A". Structural Isolated Adapter Curbs shall be Type PSAC-6200 or PSAC-6300 as manufactured by The VMC Group.

2.5 FLEXIBLE CONNECTORS

A. Type FC-2: Flexible Stainless Steel Hose SS-FP, SS-FW, SS-PM, SS-WE

- 1. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples.

B. Type BC-2 connector shall be braided bronze for Freon connections.

- 1. Minimum lengths shall be as tabulated:

<u>Flanged</u>		<u>Male Nipples</u>	
3 x 14	10 x 26	½ x 9	1 ½ x 13
4 x 15	12 x 28	¾ x 10	2 x 14
5 x 19	14 x 30	1 x 11	2 ½ x 18
6 x 20	16 x 32	1 ¼ x 12	
8 x 22			

- 2. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

PART 3- EXECUTION

3.1 EXAMINATION

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- A. All areas that will receive components requiring vibration control or wind load bracing shall be thoroughly examined for deficiencies that will affect their installation or performance. Such deficiencies shall be corrected prior to the installation of any such system.
- B. Examine all “rough ins” including anchors and reinforcing prior to placement.

3.2 APPLICATIONS

- A. All vibration isolators and wind restraint systems must be installed in strict accordance with the manufacturer’s written instructions and all certified submittal data.
- B. Installation of vibration isolators and wind restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system specified herein.
- D. The contractor shall not install any isolated components in a manner that makes rigid connections with the building unless isolation is not specified. “Building” includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Overstressing of the building structure must not occur due to overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. General bracing may occur from flanges of structural beams, upper truss cords in bar joist construction and cast in place inserts or wedge type drill-in concrete anchors.
- G. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted.
- H. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraints shall be those described in the specification when horizontal motion exceeds 3/8.”

3.3 EQUIPMENT INSTALLATION

- A. Equipment shall be isolated and/or restrained as per Tables A-E at the end of this section.
- B. Place floor mounted equipment on 4” actual height concrete housekeeping pads properly sized and doweled or expansion shielded to the structural deck. Anchor isolators and/or bases to housekeeping pads. Concrete work is specified under that section of the contract documents.
- C. Additional Requirements:
 - 1. The minimum operating clearance under all isolated components bases shall be 2.”
 - 2. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.

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3. All components shall be installed on blocks to the operating height of the isolators. After the entire installation is complete and under full load including water, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free to move in all directions, within the limits of the restraints.
4. All floor or wall-mounted equipment and tanks shall be restrained with Type V restraints.

3.4 PIPING AND DUCTWORK ISOLATION

A. Vibration Isolation of Piping:

1. HVAC Water Piping: All spring type isolation hangers shall be pre-compressed or pre-positioned if isolators are installed prior to fluid charge. If installed afterwards, field pre-compressed isolators can be used. All HVAC piping in the machine room shall be isolated as well as pressurized runs in other locations of the building 6" and larger. Type E hangers shall isolate horizontal pressurized runs in all other locations of the building. Floor supported piping shall rest on Type B isolators. Heat exchangers and expansion tanks are considered part of the piping run. The first 3 isolators from the isolated equipment shall have at least the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first 3 hangers shall have 0.75" nominal deflection or greater for pipe sizes up to and including 3," 1 3/8" nominal deflection or greater for pipe sizes greater than 3." Where column spacing exceeds 35', isolation hanger deflection shall be 2½" for pipes exceeding 3" diameter. Type L hangers may be substituted for the above where isolation hangers are required.
2. Steam and Condensate Piping: All ceiling suspended piping in the mechanical equipment room shall be isolated with Type D hangers. All floor supported piping shall be supported with Type F isolators. At locations where supports are either acting as anchors or guides, Type D and F isolators shall be deleted and anchor or guide shall be resiliently attached to the structure utilizing isolation washers and bushings to prevent metal to metal contact. Isolation washers and bushings shall be molded from Type "H" material.
3. Plumbing Water Lines: Plumbing water lines in the machine room shall only be isolated if connected to isolated equipment. (See Table B.) Isolator type shall be as listed in Article 1, above.
4. Riser Location: All risers shall be supported on Type J or K anchors or guide restraints positively attached to both the riser and structure. Spiders welded to the pipe can substitute for Type K guides using J Type anchors.
5. Control Air Piping: Where control air piping is connected to isolated components, all piping shall be isolated and equipment shall be flexibly connected in horizontal and vertical plane with Type FC-2 flexible connectors.

6. Gas lines shall not be isolated.
7. Fire protection lines shall not be isolated.

B. Vibration Isolation of Ductwork:

1. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Type A or Type E isolators. Actual spring deflection shall be a minimum of 0.75."
2. All duct runs having air velocity of 1500 feet per minute (fpm) or more shall be isolated from the building structure by Type E combination spring elastomer hangers or Type A floor spring supports. Spring deflection shall be a minimum of 0.75."

3.5 FIELD QUALITY CONTROL, INSPECTION

- A. All Independent Special and Periodic Inspections must be performed and submitted on components as outlined in Section 1.4 B, Article 4. (See also Contractor Responsibility, Section 1.4B, Article 5.) Note: Special Inspection services are to be supplied by the owner.
- B. Upon completion of installation of all vibration isolation devices, the manufacturer's chosen representative shall inspect the completed project and certify in writing to the Contractor that all systems are installed properly, or list any that require correction. The contractor shall submit a report to the Architect, including the representative's report, certifying correctness of the installation or detailing corrective work to be done.

4.0 Selection Guide For Vibration Isolation and Wind Restraints

TABLE "A" HVAC EQUIPMENT										
EQUIPMENT (See Notes)	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
	Size/Type	Mtg	Isol	Nom Defl*	Base	Restr	Isol	Nom Defl*	Base	Restr
Multiple Compressor Chillers		Floor	G	.10	---	IV	B	1.5	See Note 15	
Air Handling Units Indoor		Floor	A	0.75	---		A	1.5	---	
		Ceiling	---	---	---	---	E	0.75	---	
Air Compressor, Tank or Floor Mounted	To 10 HP	Floor	A	0.75	---		A	1.50	---	
	>10 HP	Floor	A	0.75	B-2		A	1.50	B-2	IV
Dry Coolers Outdoor Condensing Units/Condensers		Roof	---	---	---	IV	B	2.50 Minimum	B-5	IV
Axial Fans (Inline Type)		Floor	A	0.75	---		A	See Guide	---	
		Ceiling	---	---	---	---	E	See Guide	---	
Base Mounted Pumps	To 15 HP	Floor	A	0.75	B-2		A	0.75	B-2	
	>15 HP	Floor	A	0.75	B-2		A	1.50	B-2	
Boilers		Floor	G	0.10	---	IV	B	0.75	---	
Cabinet Fans & Packaged AHU Indoor	To 1 HP	Floor	F	0.20	---		A	0.75	---	
		Ceiling	---	---	---	---	A	0.75	---	
	>1 HP	Floor	A	0.75	---	=	A	See Guide	---	
		Ceiling	---	---	---	---	A	See Guide	---	
Centrifugal Chillers		Floor	B	0.75	---	IV	B	1.50	---	
Centrifugal Fans Arr. 1 & 3	Class 1	Floor	A	0.75	B-1		A	See Guide	B-1	
	Class 2 & 3	Floor	A	0.75	B-2		A	See Guide	B-2	
Centrif. Fans (Vent Sets) Arr. 9 & 10	Class 1	Floor	A	0.75	---	---	A	See Guide	See Note 4	
	Class 2 & 3	Ceiling	---	---	---	---	A	See Guide	B-2	
Computer Room Units		Floor	F	0.20	B-7	IV	B	1.5	B-7	IV
Condensate Pumps		Floor	F	0.20	If req.	IV	F	0.20	If req.	
Cooling Towers		Floor	B	0.75	---	IV	B	2.50	B-1, B-5 optional	---
Curb Mtd. Equip. (Non-Isol.)		Roof	---	---	---	IV	---	---	B-6	---
Fan Coil Units		Floor	F	0.20	---		A	0.75	---	
		Ceiling	---	---	---	---	E	0.75	---	
Outdoor Reciprocating, Rotary or Screw Chillers		Floor				IV	B	1.50	---	---
		Roof	---			IV	B	2.50	B-5	---
Rooftop AHU/AC (curb mounted)	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-3 See Notes 5,6	---
	> 10 Ton	Roof	---	---	---	IV	B	2.50	Vibration Isolation, Wind & Load Restraints See Notes 5,6,8 - 22	---
Rooftop AHU/AC (dunnage mounted)	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-8	---
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-8	---

**See Minimum Deflection Guide for Equipment with Low RPM*

TABLE "B" PLUMBING EQUIPMENT										
EQUIPMENT (See Notes)	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
	HP	Mtg	Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Air Compressors & Vacuum Pumps	Up to 10	Floor	A	0.75	---		A	1.50	---	
	Over 10	Floor	A	0.75	B-2		A	1.50	B-2	
Base Mounted Pumps	Up to 15	Floor	A	0.75	B-2		A	0.75	B-2	
	Over 15	Floor	A	0.75	B-2		A	1.50	B-2	

TABLE "C" ELECTRICAL EQUIPMENT										
EQUIPMENT (See Notes)	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
	Size	Mtg	Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Transformers (Dry Type)	All	Floor	---	---	---	IV	D	0.30	*	IV
		Ceiling	---	---	---	V	E	0.20	*	V
Generators	All	Floor	B	1.0	---	IV	B	1.50	*	IV
Generators	All	Over Occupied Space	---	---	---	---	B	2.50	*	IV
UPS Systems	M	All	---	---	---	---	B	1.50	*	IV

*Where Component cannot be point supported, Base Type B-1 shall be used.

Minimum Deflection Guide for Equipment with Low RPM

Lowest RPM of Rotating Equipment	Minimum Actual Deflection
Less Than 400	3.5"
401 thru 600	2.5"
601 thru 900	1.5"
Greater than 900	0.75"

General Notes for All Tables:

1. Abbreviations:
 - (1) Mtg = Mounting
 - (2) ol = Vibration Isolator Type per Section 2.2, Vibration Isolation Types
 - (3) Defl = Minimum Deflection of Vibration Isolator
 - (4) Base = Base Type per Section 2.4, Equipment Bases
 - (5) Restr = Seismic Restraint Type per Section 2.3 Seismic Restraint Types
2. All deflections indicated are in inches.
3. For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide.
4. For roof applications, use base Type B-5.
5. Specification Option #1 called out on equipment schedule in curb Type B-3 shall use sound barrier RPFMA when there is no concrete under rooftop units and this option is selected. Curbs can be used for return plenums. (See Option #1 under curb type B-3.)
6. Specification Option #2, called out on equipment schedule in curb Type B-3 shall be used where curbs require supply and return sound attenuation package type SPFMA shall be used. (See Option #2 under curb type B-3.)
7. Units may not be capable of point support. Refer to separate air handling unit specification section. If that section does not provide base and external isolation is required, provide Type B-1 base by this section for entire unit.
8. Static deflection shall be determined based on the deflection guide for Table "A."
9. Deflections indicated are minimums at actual load and shall be selected for manufacturer's nominal 5," 4," 3," 2" and 1" deflection spring series; RPM is defined as the lowest operating speed of the equipment.
10. Single stroke compressors may require inertia bases with thicknesses greater than 14" maximum as described for base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8."
11. Floor mounted fans, substitute base Type B-2 for class 2 or 3 or any fan having static pressure over 5."
12. Indoor utility sets with wheel diameters less than 24" need not have deflections greater than .75."
13. Curb-mounted fans with curb area less than 9 square feet are excluded.
14. For equipment with multiple motors, Horsepower classification applies to largest single motor.
15. Provide additional dunnage under chiller.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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 and other sections of Division 21.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

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- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.
- D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

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- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- I. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.
- D. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

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- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- D. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Permanently colored conductors. Insulation of conductors to be colored at factory.
- B. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

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1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE RE-INFORCED DETECTABLE WARNING TAPE

- A. Tape:
 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
 4. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 5. Overall Thickness: 8 mils.
 6. Foil Core Thickness: 0.35 mil.
 7. Weight: 34 lb/1000 sq. ft..
 8. 3-Inch Tensile According to ASTM D 882: 300 lbf, and 12,500 psi.

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. "DANGER - 480 VOLT."

2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

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- C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.10 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F.
 - 5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above wooden plank above line at 6 to 8 inches below finished grade. Install one (1) length of tape above each 12" wide warning plank.
- J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.
- K. All conductors utilized for power applications to be permanently colored.

3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH

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VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.
- D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Emergency Power: Painted Orange.
 2. Standby Power: Painted Black.
 3. UPS: Painted Blue.
 4. Fire Alarm: Painted Red.
 5. Conditioned Power: Painted Grey.
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, conduits and handholes permanently color coded, so as to indicate a clear differentiation between phase wires of different voltage systems, between each phase of voltage system and between each phase and neutral of each voltage system. In all cases, grounded neutral wires and cables shall be identified by the colors white or gray. To differentiate the grounded neutral wires of different voltage systems, white shall be used for those of the lower voltage system and gray for those of the higher.
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral: White.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.

- 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral: Gray.
- d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
2. Provide laundry tags on conductors at each junction box, pull box, outlet box, and enclosure. Wrap rope for laundry tag around all wires in one circuit (including all wires in multi wire circuits) indicate fed from location and circuit #.
- F. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.
- G. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 2. Equipment to be labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label. Indicate the following: Panel Name, Feeder size, Voltage, # of wires, Phase, Feeder Origination, Switch and Fuse/Breaker size at source/available fault current. (All information to be indicated on outside cover of surface-mounted panelboards. Flush-mounted panelboards to indicate Panel Name on outside cover and all other information on inside cover.)
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards. Indicate the following: Panel Name, Feeder size, Voltage, # of wires, Phase, Feeder Origination, Switch and Fuse/Breaker size at source, available fault current.

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- e. Fire alarm system boxes and enclosures. Indicate "Fire Alarm" painted red.
- f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, emergency system boxes and enclosures and panelboards or equipment supplied by the secondary.
- g. Substations.
- h. Emergency system boxes and enclosures. Indicate "EM" painted orange.
- i. Motor-control centers. Indicate equipment being controlled.
- j. Enclosed switches. Indicate equipment being controlled.
- k. Enclosed circuit breakers. Indicate equipment being controlled.
- l. Enclosed controllers. Indicate equipment being controlled.
- m. Variable-speed controllers. Indicate equipment being controlled.
- n. Push-button stations. Indicate equipment being controlled.
- o. Power transfer equipment. Indicate fed from normal source and fed from back-up source.
- p. Contactors. Indicate equipment being controlled and capacity.
- q. Remote-controlled switches, dimmer modules, and control devices. Indicate equipment being controlled.
- r. Battery-inverter units. Indicate capacity, voltage, number of wires and phase.
- s. Battery racks. Indicate capacity and equipment served.
- t. Power-generating units. Indicate voltage, number of wires, phase, sizes of main circuit breakers and locations of associated transfer equipment.
- u. Monitoring and control equipment. Indicate equipment being controlled and monitored
- v. UPS equipment. Indicate capacity, voltage, number of wires, phase, equipment being served and main breaker size.
- w. UPS system boxes and enclosures. Indicated as "UPS" and painted blue.
- x. Lighting control system equipment (indicate zones being controlled)
- y. Grounding enclosures
- z. Time clock override switch (indicate "Override Switch").
- aa. Switched/dimmed receptacles. Indicate device controlling receptacle. Indicate "Controlled receptacle – "Do not exceed ratings of control device".
- bb. Receptacles. Indicate panel-board and associated circuit serving receptacle with label on faceplate.

END OF SECTION 260553

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer. Study to be stamped with engineers PE stamp.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.
- E. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
- B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. ETAP
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Utility Transformer kilovolt amperes, size, voltage, and source impedance.
 - d. Customer transformer kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Motor horsepower and code letter designation according to NEMA MG 1.
 - g. Generator kilovolt amperes, size, voltage, and source impedance.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Utility Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Customer transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - d. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 1. Switchgear and switchboard bus.
 2. Motor-control center.
 3. Distribution panelboard.
 4. Branch circuit panelboard.
 5. Automatic transfer switches.
 6. Fire pump controllers/transfer switches.
 7. Generator main circuit breakers.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.

1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
2. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study. Prepare a written report using results of fault-current study. Comply with National Electrical Code selective coordination requirements for service equipment over 600 A; emergency systems, legally hard systems, and elevator feeders.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Utility and Customer Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

C. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

- D. Coordination-Study Report: Prepare a written report indicating one of the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each utility transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- E. Completed data sheets for setting of overcurrent protective devices.
- F. Submit coordination study to Con Edison. Indicate fire pump controller/transfer switch as a CTTS.
- G. Revise overcurrent protection of emergency equipment if required for coordination.
- H. Coordination study may utilize the following to indicate code compliance:
1. Breaker or fuse coordination tables.
 2. Intersection graphs of time current curves.
 3. Results of software calculation.
- 3.5 ARC-FLASH HAZARD ANALYSIS
- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
 - B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.
 - C. Calculate maximum and minimum contributions of fault-current size.

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1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at location in the electrical distribution system where personnel could perform work on energized parts.
- E. Include low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors shall be decremented as follows:
1. Fault contribution from induction motors should not be considered beyond three to five cycles.
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

END OF SECTION 260573

SECTION 260801 - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The requirements of the General Conditions, Supplementary Conditions and the following specification sections apply to all Work herein.
- B. Vibration, seismic, wind & flood criteria for this section is referenced in specification Section 230548. Vendor/manufacturer/contractor is responsible for this and Section 230548 in its entirety.

1.2 SUMMARY

- A. Provide all testing to demonstrate proper operation as required by these Specifications and the authorities having jurisdiction of the electric system, equipment and components as indicated on the Drawings and as specified herein. Tests shall include, but not be limited to the items specified in this section and in other Division 26 Specification sections.

1.3 QUALITY ASSURANCE

- A. Submit evidence to show that the personnel who will actually test the systems are qualified to perform the required Work.
- B. All test procedures shall be in accordance with the manufacturer's recommendations for the equipment being tested.

1.4 SUBMITTAL DATA

- A. The following submittal data shall be furnished according to the General Conditions and Section 10000 and shall include, but not be limited to:
 - 1. Test Procedures for all tests proposed.

2. Recording Forms.
 3. Test Data and Results including the following:
 - a. Test performed.
 - b. Test procedure.
 - c. System and area tested.
 - d. Date(s) and time(s) of test.
 - e. Weather conditions.
 - f. Test criteria.
 - g. Test results.
 - h. Additional pertinent data.
 - i. Instruments including documentation that such instruments were properly calibrated at the time of the testing.
 - j. Personnel and Qualifications
- B. All items or equipment listed above with asterisks (*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Section 10000. See Section 10000 for certification requirements.

PART 2 - PRODUCTS

2.1 TESTING MATERIALS

- A. Provide all materials, including fuels where required, supplies, services, temporary equipment and test equipment required for testing of specified electrical system components as well as integrated system tests, including any retests required to obtain acceptable results.
- B. Testing materials that fail to provide acceptable test results shall be repaired or replaced with suitable materials as required to obtain acceptable test results.

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. Refer to the various Division 26 Specification sections for requirements for factory testing of equipment and devices.

3.2 FIELD TESTING OF ELECTRICAL SYSTEMS

- A. The entire electrical installation shall be inspected by the manufacturer and tested by the Electrical Contractor to ensure safety to building occupants and operating personnel, conformity to Code authorities and Contract Documents, including the General Conditions for design services and construction procedures. The Contractor shall obtain, at no cost to the Owner, a certificate of completion from the Fire Underwriters for the State of New York.
- B. Recognized safety procedures and techniques shall be used during energizing and de-energizing of all equipment to ensure employee safety and protect the work.
- C. During the progress of the Work and upon completion, tests shall be made as specified herein and as required by authorities having jurisdiction including inspectors, Owner, Owner's insurance agency, Architect or Engineer. Tests shall be witnessed by the Electrical Contractor as part of the Work of this Division and shall include the services of qualified personnel as well as all equipment, apparatus, and services required. Each wiring system with devices connected must test free from short circuits and from grounds and must have an insulation resistance between conductors and ground, based on maximum load, not less than the requirements of the latest edition of the National Electrical Code and relevant industry standards such as NETA, IEEE, ANSI, NEMA, ASTM, etc.
- D. Prior to the execution of testing, the Electrical Subcontractor shall submit in writing proposed test procedures, recording forms, list of personnel and qualifications and test equipment for the Engineer's, Owner's, and CA's review.
 1. Procedures shall include operation of entire electrical power system including:
 - a. Voltage and current readings for each feeder and motor circuit under maximum operating conditions. Readings shall be submitted to the Engineer for review. Readings questioned shall be repeated for confirmation.
 - b. Operation of lighting and receptacle circuits with associated switching and controls.
 - c. Running of motors with demonstration of controls and interlocks.
 - d. Operation of transformers (new and existing scope of work area) with voltage check while loaded to assure proper transformer tap settings.
 - e. Operation of electrical equipment and appliances whether provided under this Division or not.
 - f. Ground fault protection system testing and calibration after construction is completed and prior to final acceptance.
 - g. Demonstration and operating test of the entire Fire Detection, Alarm and Communication System as required by the Owner and the local authorities.

E. Factory and Site Testing

1. Each of the following factory tests and/or inspections indicated in these documents shall be attended by the Electrical Contractor. The factory testing will familiarize the Contractor with the equipment and testing procedures that will be required at the site and allow the Contractor to inspect the equipment to be installed prior to shipment.
2. Pre-Testing: After installation, all devices are tested by the contractor as prerequisite for functional and acceptance testing. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Results of pre-testing shall be submitted for all devices. Prepare forms for systematic recording of acceptance test results.
3. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.
4. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final Owner acceptance testing.
5. The following site tests shall be performed by the Electrical Contractor as part of this Contract scope:
 - a. As part of these tests, where heat runs or "burn-ins" are included, infrared scanning shall be performed on all associated equipment during the full duration of the test.
 - b. Load banks, cables and connections for all heat runs shall be provided for all of the following tests, as part of this Contract.

3.3 EQUIPMENT TESTING

- A. Cable Testing - This section refers to testing of feeders and sub feeds in excess of #2 (equipment feeds to XFMR's, panel, large equipment, etc.) for feeders serving equipment rated at/under 600V, all feeders and sub feeders in excess of 600V, and feeders serving any existing panelboards to remain that are being reused.
1. Cables shall be megger tested. Individual cables shall be megger tested on an individual basis.
 2. Grouping of phase conductors for a group measurement shall not be permitted.
 3. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps, and connections are made and prior to final connection to source or load.
 4. Insulation resistance of conductors which are to operate at 600 volts or less shall be tested by using Biddle (or approved equal) Megger with an output of not less than 1000 volts d.c. Conductors shall be tested between phase conductors, between each phase conductor and

neutral and ground, and between neutral and ground, cables not under test to be grounded. Reading shall be observed after 1 minute of operation of the Megger. Insulation resistance of conductors rated at 600 volts shall be not less than one hundred (100) mega-ohms. If readings have not stabilized in 60 seconds, record stabilization time and results in appropriate table on cable functional form. If readings are less than 100 megohms or if there is a discrepancy of greater than 25% between individual feeders, Testing company to inform Contractor and Owner.

5. Conductors that do not exceed insulation resistance values listed above shall be completely removed (source to load) and replaced at contractors expense and test repeated. The Contractor shall furnish all instruments and personnel required for tests.
6. For all conductors' size #2 and larger and conductors over 600V, the Contractor shall tabulate readings observed using supplied cable megger forms and shall forward four copies of test readings to the Engineer for review. These test reports shall identify each conductor tested, date and time of test, weather conditions, temperature, and relative humidity. Each test shall be signed by party making the test. Any conductor or splice which is found defective shall be promptly removed and replaced, and additional tests shall be performed.
7. All feeders which can be paralleled shall be tested for proper phasing using hot phasing or other approved techniques.

B. Panelboards

1. Following the installation of branch circuitry, phase currents shall be verified to ensure the balance of loads. Branch circuitry shall be reconnected to achieve a maximum imbalance of 10%.
2. Megger test the main bus of each panel.
3. Verify voltage and phase rotation at the main of the panel after energizing the panel.
4. Infrared scan panel-board at 40% load to review for hot spots.
5. Acceptance Testing Preparation:
 - a. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - b. Test continuity of each circuit.
6. Tests and Inspections:
 - a. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - c. Perform the following infrared scan tests and inspections and prepare reports:

- 1) Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - 2) Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - 3) Instruments and Equipment:
 - a) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
7. Panelboards will be considered defective if they do not pass tests and inspections.
 8. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Receptacles
1. Receptacles shall be tested for polarity.
 2. Tests For Convenience Receptacles:
 - a. Line Voltage: Acceptable range is 105 to 132 V.
 - b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - c. Ground Impedance: Values of up to 2 ohms are acceptable.
 - d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - e. Using the test plug, verify that the device and its outlet box are securely mounted.
 - f. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
 3. Test relays controlling receptacles for proper operation.
- D. Light Switches, Occupancy Sensors, Dimmers
1. Light switches, occupancy sensors and wall mounted dimmers shall be operationally tested for proper operation.
- E. Bus Ducts

1. Infrared scan bus duct for hot spots.
2. Verify torque of existing bus duct.

F. Sub-Metering Equipment

1. Test all functions of sub-metering equipment against portable metering equipment. Verify that metered values are within 10% of each other.

G. Transformers

1. Infrared scan for hot spots.

H. Lighting Battery Ballasts/Inverters

1. Battery ballasts/inverters shall have an operational test performed following installation.

I. Lighting Relay Panels

1. Lighting relay panels shall have automatic and manual operational tests performed following the completion of the installation of the panel and override switches (where included).
2. Simulated programming times (i.e., "On", "Off") shall be input by the Contractor for the test, and following the completion of the test, the actual "on/off" times as required by the Owner shall be input into the system.

J. Dimming Systems

1. Dimming systems shall have automatic and manual operational tests performed following the completion of the installation of the dimming systems and their associated remote controls.
2. Initial dimming settings shall be input by the Contractor for the test based on the requirements of the Owner.

K. Motors and Starters

1. Motor starters (and motors) shall have automatic and manual operational tests performed following the completion of the installation of the motors and their starters or variable frequency drives.
2. Motors shall be operated for a minimum of one (1) hour with infrared scanning performed on the feeders, starters (and VFD's) and motors.

L. TVSS

1. Verify the proper operation of all TVSS devices using the manufacturer's approved diagnostic test kit. Verify 0.5 ohms maximum ground continuity to all units.

M. Heat Tracing Cable

1. Heating cable shall be megger tested. Megger tests shall be performed at two periods during installation; while the cable is still on the reel prior to installation and at the completion of the installation.
2. Megger testing shall include a 2500 VDC megaohmmeter between wires and the grounding braid with a minimum reading of 20 megaohms.

N. Central Inverter System

1. Stimulate loss of power and verify inverter operates.

O. Switchboards

1. Acceptance Testing Preparation
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - b. Test continuity of each circuit.
2. Tests and Inspections
 - a. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - c. Perform the following infrared scan tests and inspections and prepare reports:
 - 1) Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
 - 2) Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - 3) Instruments and Equipment
 - a) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- d. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
3. Switchboard will be considered defective if it does not pass tests and inspections.
4. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

P. Generator

1. Tests and Inspections

- a. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

1) Visual and Mechanical Inspection

- a) Compare equipment nameplate data with drawings and specifications.
- b) Inspect physical and mechanical condition.
- c) Inspect anchorage, alignment, and grounding.
- d) Verify the unit is clean.

2) Electrical and Mechanical Tests

- a) Perform insulation-resistance tests in accordance with IEEE 43.
 - (1) Machines larger than 200 horsepower (150 kilowatts). Test duration shall be 10 minutes. Calculate polarization index.
 - (2) Machines 200 horsepower (150 kilowatts) or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.
- b) Test protective relay devices.
- c) Verify phase rotation, phasing, and synchronized operation as required by the application.
- d) Functionally test engine shutdown for low fuel pressure, overtemperature, overspeed, and other protection features as applicable.
- e) Conduct performance test in accordance with NFPA 110.
- f) Verify correct functioning of the governor and regulator.

- b. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - c. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - 1) Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - 2) Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - 3) Verify acceptance of charge for each element of the battery after discharge.
 - 4) Verify that measurements are within manufacturer's specifications.
 - d. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 - e. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 - f. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 - g. Exhaust Emissions Test: Comply with applicable government test criteria.
 - h. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 - i. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 - j. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line and compare measured levels with required values.
- 2. Coordinate tests with tests for transfer switches and run them concurrently.
 - 3. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
 - 4. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

5. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
7. Remove and replace malfunctioning units and retest as specified above.
8. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
9. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
10. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.
 - a. Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
11. On-Site Acceptance Test:
 - a. Upon completion of installation of engine-generator system, and after building circuitry has been energized with normal power source, test engine-generator to demonstrate standby capability and compliance with requirements. Submit for approval an on-site testing plan for approval minimum 30 days prior to scheduling of test. Provide a minimum of 12 hours premium and 4 hours non-premium on site for manufacturers start up by qualified personnel. Test the complete system with full load bank test for minimum 8 hours; load bank shall be connected on the load side of the Automatic Transfer Switch. Installation of load bank with all required wiring, mounting of load bank, fuel, and required labor to be included in this scope of work.
 - b. Test Requirements:
 - 1) Engine shall be capable of attaining rated voltage and frequency under no-load conditions, within 10 seconds of start signal.
 - 2) Full-load test of eight (8) hours. The generator shall maintain rated voltage +/- 5 V and +/- 0.5 Hz for duration of full load.

- 3) Steady state performance from 0-100, utilizing 25% increments and holding for 10 minutes. Performance shall conform to specifications.
 - 4) Recording of transients (0-100%, 0-50%, 50-0%, 25-75%, 75-25%).
- c. Engage local equipment manufacturer's representative to perform start-up and building load test upon completion of installation, with the Engineer in attendance; provide certified test record. Tests are to include the following:
- 1) Check fuel, lubricating oil, and antifreeze for conformity to the manufacturer's recommendations under environmental conditions present.
 - 2) Check, during start-up test mode, for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.
 - 3) Upon completion of installation, demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest with new units, and proceed with retesting. Any retesting necessary will be at no additional cost to Owner.
 - 4) Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.
- d. Load banks to be suitcase-type for accessible rigging.
- e. Engage local equipment manufacturer's representative to perform start-up and building load test upon completion of installation, with the Engineer in attendance; provide certified test record. Tests are to include the following:
- 1) Check fuel, lubricating oil, and antifreeze for conformity to the manufacturer's recommendations under environmental conditions present.
 - 2) Check during start-up test mode, for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.
 - 3) Upon completion of installation demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest with new units, and proceed with retesting. Any retesting necessary will be at no additional cost to Owner.

Q. Transfer Switches

1. Testing Agency: Engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.
2. Perform tests and inspections and prepare test reports.
 - a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - b. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - c. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - d. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - 1) Check for electrical continuity of circuits and for short circuits.
 - 2) Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - 3) Verify that manual transfer warnings are properly placed.
 - 4) Perform manual transfer operation.
 - e. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - 1) Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - 2) Simulate loss of phase-to-ground voltage for each phase of normal source.
 - 3) Verify time-delay settings.
 - 4) Verify pickup and dropout voltages by data readout or inspection of control settings.
 - 5) Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 - f. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - 1) Verify grounding connections and locations and ratings of sensors.
3. Testing Agency's Tests and Inspections

- a. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - b. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - c. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - 1) Check for electrical continuity of circuits and for short circuits.
 - 2) Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - 3) Verify that manual transfer warnings are properly placed.
 - 4) Perform manual transfer operation.
 - d. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - 1) Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - 2) Simulate loss of phase-to-ground voltage for each phase of normal source.
 - 3) Verify time-delay settings.
 - 4) Verify pickup and dropout voltages by data readout or inspection of control settings.
 - 5) Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
4. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
 5. Remove and replace malfunctioning units and retest as specified above.
 6. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - a. Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- c. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

- R. Emergency Lighting - Simulate loss of power source and use light meter to measure the following:
 - 1. FC at floor level within stairs.
 - 2. FC at floor level directly outside of exit.
 - 3. FC at floor level at entrance door and stair.
 - 4. FC at floor level at corridor intersections and change of direction/elevation.
 - 5. FC at floor level and at 18 inches above floor throughout corridor and in path of egress.

3.4 SYSTEMS TESTING

A. Integrated System Testing

- 1. Refer to commissioning specifications for full pull the plug/integrated systems test. Test shall not be conducted as an extension of on-site generator acceptance test but rather a separate test after project substantial completion. Generator, ATS, and Elevator Manufacturers are required to be in attendance for testing. All sub-contractors to be in attendance.

B. Grounding Systems

- 1. The grounding systems shall be tested for stray currents and ground shorts at the completion of the installation.
- 2. Ground testing shall consist of opening all main disconnects for the system being tested and disconnecting the system neutral from the service entrance or step-down transformer neutral connection. D.C. ohmmeter shall measure resistance across the system neutral and equipment ground.
- 3. Readings in excess of 100 ohms shall indicate that the system neutral and equipment ground are properly isolated.
- 4. Ohmmeter reading less than 100 ohms shall indicate that the system contains ground shorts (stray currents) at some point along the system neutral.
- 5. Telecommunications Signal Ground System: The Signal Reference Grounding Systems (SRGS) shall be tested as follows:
 - a. The Contractor shall make a.c. current measurements on all grounding and bonding conductors for the SRG. The a.c. current on any portion of the SRG should not

exceed 250 mA. A.c. current exceeding this level will cause voltages that can affect data signals.

- b. Measure the equipment-grounding conductor on all a.c. branch circuits and/or equipment enclosures to verify impedance less than 0.1 ohm. (This measurement should be made with a ground impedance tester.)
- c. Take two-point bonding measurements between the SRG and all building grounding electrodes. The resistance measurements between any two (2) points should be less than 0.1 ohm. (This measurement should be made using an earth-ground tester in a two-point configuration.)
- d. Make common-mode voltage measurements between different grounding planes within the data processing room to help pinpoint EMI/RFI on any grounding plane. (This measurement should be made using an oscilloscope and a line viewer.)
- e. Use an RFI locator to find any significant sources of Radio Frequency Interference (RFI).
- f. Employ a gaussmeter to help locate significant sources of Electro-Magnetic Interference (EMI).
- g. Tighten all connections once a year to uncover loose connections.
 - 1) Grounded neutrals may be identified by disconnecting individual neutral conductors from the system one at a time while monitoring the ohmmeter.
 - 2) Ground systems shall be retested after correction of all ground shorts is complete.

C. Fire Alarm System

1. The fire alarm system tests shall include, but not limited to the following:
 - a. A complete operational test of the fire alarm system shall be performed. A written "Acceptance Test Procedure" (ATP) for testing the fire alarm system components and installation will be prepared by the Contractor in accordance with NFPA 72 and this Specification. The Contractor shall be responsible for the performance of the ATP, demonstrating the function of the system, and verifying the correct operation of all system components, circuits and programming.
2. Acceptance testing to be witnessed by Owner, Engineer and Commissioning Agent shall include the following:
 - a. Testing of all devices in scope of work.
 - b. Verify interface with security system.
 - c. Testing of smoke control/exhaust systems.
 - d. Elevator interface.

- e. If any portions of the witness test fail, owner reserves the right to witness testing of additional devices, subsystems and entire floors, etc., at no additional cost.
 - 1) In addition to the operational and Owner's acceptance testing this Contractor shall make all the required arrangements to have the Fire Department witness the operation of the system.
 - 2) In addition to the complete system integration test (operational), any subsystems, or partial system completions that must be tested for early activation of the life safety systems shall also be included. The Construction Manager shall define the schedule of all areas, which must be completed in advance of the complete system.
 - 3) Testing shall include the manual and automatic activation verification of all fire alarm initiating (input alarms and trouble indications) and output functions as listed in the system operation matrix.
 - 4) Each addressable analog smoke detector shall be individually field tested prior to installing the device at its designated location to ensure reliability after shipment and storage conditions. A dated log indicating correct address, type of device, sensitivity and initials of the technician performing test - using test equipment specifically designed for that purpose - shall be prepared and kept for final acceptance documentation. After testing, the detection devices and base shall be labeled with the system address, date and initials of installing technician. Labeling shall not be visible after installation is complete.
 - 5) Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
 - a) A systematic record shall be maintained of all readings using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates and witnesses.
 - b) The acceptance inspector shall be notified before the start of any required tests. All items found at variance with the drawings or this Specification during testing or inspection by the acceptance inspector shall be corrected.
 - c) Test reports shall be delivered to the acceptance inspector as completed.
- 3. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing Contractor. The following equipment shall be a minimum for conducting the tests:
 - a. Multimeter for reading voltage, current and resistance.

- b. Intelligent device programmer-tester.
 - c. Laptop computer with programming software for any required program revisions.
 - d. Two-way radios, flashlights, smoke generation devices and supplies.
 - e. Spare printer paper.
 - f. An approved device for measuring air flow through air duct smoke detector sampling assemblies.
 - g. Decibel meter.
 - h. Testing documentation.
 - i. Ladders and scaffolds as required to access all installed equipment.
4. A final "as-built" function matrix shall be prepared by the installing Contractor referencing each alarm input to every output function affected as a result of an alarm, trouble or supervisory condition on that input. In the case of outputs programmed using more complex logic functions involving "any", "or", "not", "count", "time", and "timer" statements, the complete output equation shall be referenced in the matrix.
 5. A complete listing of all device labels for alphanumeric annunciator displays and logging printers shall be prepared by the installing Contractor prior to the ATP.
 6. The Owner's acceptance testing shall in addition to the items listed under 5.1.2 include, but not be limited to, the following:
 - a. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - 1) Activation of all initiating devices.
 - 2) Open, shorted and grounded intelligent analog signaling circuit.
 - 3) Open, shorted and grounded network signaling circuit.
 - 4) Open, shorted and grounded conventional zone circuits.
 - 5) Open, shorted and grounded speaker, telephone circuits.
 - 6) Intelligent device removal.
 - 7) Primary power or battery disconnected.
 - 8) Incorrect device at address.
 - 9) Printer trouble, off line or out of paper.
 - 10) Loss of data communications between system control panels.
 - 11) Loss of data communications between system annunciators.
 - b. System evacuation alarm indicating appliances shall be demonstrated as follows:
 - 1) All alarm notification appliances actuate as programmed.
 - 2) Audibility and visibility at required levels.
 - c. System indications shall be demonstrated as follows:

- 1) Correct message display for each alarm input at the control panel, each remote alphanumeric LCD display.
 - 2) Correct annunciator light for each alarm input, at each annunciator and color graphic terminal.
 - 3) Correct printer logging for all system activity.
- d. System on-site and/or off-site reporting functions shall be demonstrated as follows:
- 1) Correct alarm custom message display, address, device type, date and time transmitted for each alarm input.
 - 2) Correct trouble custom message display, address, device type, date and time transmitted for each alarm input.
 - 3) Trouble signals received for disconnect.
- e. Secondary power capabilities shall be demonstrated as follows:
- 1) System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
 - 2) System primary power shall be restored for forty-eight (48) hours and system charging current shall be normal trickle charge for a fully charged battery bank.
 - 3) System battery voltages and charging currents shall be checked at the fire alarm control panel using the test codes and displayed on the LCD display.
7. In the event of system failure to perform as specified and programmed during the ATP procedure, at the discretion of the acceptance inspector, the test shall be terminated.
- a. The installing Contractor shall retest the system, correcting all deficiencies and providing test documentation to the acceptance inspector.
 - b. In the event that software changes are required during the ATP, a utility program shall be furnished by the system manufacturer to compare the edited program with the original. This utility shall yield a printed list of the changes and all system functions, inputs and outputs affected by the changes. The items listed by this program shall be the minimum acceptable to be retested before calling for resumption of the ATP. The printed list and the printer log of the retesting shall be submitted before scheduling of the ATP.
 - c. The acceptance inspector may elect to require the complete ATP to be performed again if, in his opinion, modifications to the system hardware or software warrant complete retesting.

D. Technology Room Testing

1. All Technology Rooms shall undergo individual room tests prior to complete integrated building tests as mentioned hereinafter.
2. These individual room tests shall be a complete test of all MEP infrastructure systems serving the room including EPS, UPS, EPO's, PDU's, Pre-Action Sprinkler, HVAC, etc.
3. These tests will include the provision of multiple load banks to simulate full system load in each room for a period of up to two hours after achieving maximum load and temperature thresholds. Functionality and redundant capabilities of equipment and systems shall be tested for each room.
4. Load banks and load bank cabling shall be furnished and installed as part of this Contract for all tests.

3.5 GENERAL

- A. The formal test procedures for all of the above-mentioned tests and their associated commissioning forms will be provided at a future date. No test will be considered complete until these forms have been submitted to the Owner and Engineer and have been found to meet the design criteria.
- B. Submit six (6) copies of each complete test report specified herein to the Engineer for review and send two (2) copies of each report to the Owner. See Section 260500 for requirements. The Contractor shall submit individual test reports for each individual system within two (2) weeks after completion of testing.
- C. The foregoing shall in no way relieve the Contractor of any warranty requirements.
- D. After the electrical distribution system, including all new switchgear, distribution panels, busways, transformers, control panels, motor controllers, lighting panels, etc. and equipment conductor terminations, has been checked, adjusted, finally calibrated and under load just prior to substantial completion as determined by the Project's construction schedule, it shall be subjected to a thermograph test using an infrared temperature scanning unit. This test shall be performed by Cutler Hammer, Square D, Siemens, General Electric Company Instrumentation Division or a factory authorized service testing organization. Two (2) copies of the test report shall be furnished to the Engineer upon completion of test. Connections indicated having higher temperatures than acceptable will be tightened or corrected as required. After corrections have been made the connections shall be subjected to an additional thermograph by the Electrical Subcontractor and rechecked to confirm that the problem has been corrected.

END OF SECTION 260801

SECTION 260923

LIGHTING CONTROL DEVICES

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 and other sections of Division 21.
- B. Vibration and wind criteria for this section is referenced in specification, "Vibration Isolation for HVAC, Plumbing, and Electrical Components," section 230548. Vendor/manufacturer/contractor is responsible for this section 230548 in its entirety.

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Occupancy/vacancy sensors.
 - 3. Time clocks.
 - 4. Lighting contractors.
- B. Related Sections include the following:
 - 1. Division 26 Sections "Central Dimming Controls" for architectural dimming system equipment.
 - 2. Division 26 Section "Network Lighting Controls" for low-voltage, manual and programmable lighting control systems.
 - 3. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

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- B. Shop Drawings: Show installation details for occupancy/vacancy and light-level sensors.
 - 1. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.
 - 2. Submit lighting plans clearly marked by manufacturer showing proper product location and orientation of each sensor, sensor range, and show all lighting fixtures, diffusers and sprinkler head locations in detail and proper placement of sensor.
 - 3. Submit any interconnection diagrams showing proper wiring. Wiring diagrams to be job specific.
 - 4. Submit standard catalog literature, which includes performance specifications indicating compliance to the specification.
 - 5. Catalog sheets must clearly state any load restrictions when used with electronic ballasts.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.
- C. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.
- D. Contractor shall warrant all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with specification. The suppliers' obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment, which are found to be damaged, defective or nonconforming and returned to the supplier. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.
- B. Final location of all devices to be in accordance with Manufacturers installation guidelines.

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PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS/PHOTOCELLS

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturers, part numbers as indicated on wiring diagrams and schedule.

1. Lutron
2. Leviton
3. Wattstopper
4. Pass and Seymour
5. Hubbell

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, switch will be manual on or off and auto off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit where indicated.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
8. All products of same type to be by a single manufacturer.

C. Sensors

1. Corner mounted low voltage dual technology occupancy sensor
 - a. Leviton OSW-12
 - b. Wattstopper DT-200
2. Ceiling mounted low voltage dual technology occupancy sensor

- a. Leviton OSC-20
- b. Wattstopper DT-300
3. Wall mounted dual relay, dual technology occupancy sensor/switch
 - a. Leviton OSSMD
 - b. Wattstopper DW-200
 - c. Pass and Seymour WDT-200W
 - d. Hubbell Light Hawk LHMTS1W
4. Wall mounted single relay dual technology occupancy sensor/switch
 - a. Leviton OSSMT
 - b. Wattstopper DW-100
 - c. Pass and Seymour WDT-100W
 - d. Hubbell Light Hawk LHMTD2
5. Ceiling mounted line voltage dual technology occupancy sensor:
 - a. Leviton OSC-20 with OS-P5-15 Line voltage power base (rated at 15A)
 - b. Wattstopper DT-355
 - c. Hubbell CU 1500200P
6. Low voltage outdoor motion sensor
 - a. Wattstopper EW-205-24
7. Wall mounted dual relay dual technology, three-way occupancy sensor/switch:
 - a. Leviton OSSMD
 - b. Wattstopper DW-203
 - c. Hubbell LHMTS1W
8. Wireless corner mounted vacancy sensor
 - a. Lutron LRF2VW
9. Wireless corner mounted occupancy sensor
 - a. Lutron LRF2OW
10. Wireless ceiling mounted occupancy vacancy sensor
 - a. Lutron LRF2-OCR2G - P
11. Wall mounted single relay, dual technology, three-way occupancy sensor/switch:
 - a. Leviton OSSMT

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- b. Wattstopper DW-103
- c. Hubbell LHMTD2

- D. Override switches
 - 1. Wall mounted low voltage occupancy sensor override switch.
 - a. Leviton 56081-2W
 - b. Wattstopper DCC2
 - 2. Wireless override wall switch/wall dimmer
 - a. Lutron MRF2 Series

- E. Relay Pack
 - 1. Relay pack capable of being wired as manual on or auto on with internal HVAC control relay.
 - a. Leviton OSP20-RDH
 - b. Wattstopper BZ150

- F. Digital Sensor System
 - 1. Digital Room Controllers:
 - a. Wattstopper LMRC-102
 - 2. Ceiling mounted digital dual technology sensor
 - a. Wattstopper LMDC-100
 - 3. Digital Wall Switches
 - a. Single Relay/Zone: LMSW-101
 - b. Dual Relay/Zone: LMSW-102
 - c. Three Relay/Zone: LMSW-103
 - d. Four Relay/Zone: LMSW-104
 - 4. Wireless configuration tool:
 - a. Wattstopper LMCT-100
 - 5. Corner mounted digital dual technology sensor
 - a. Wattstopper LMDX-100

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2.2 TIME SWITCHES

- A. Time switches to be Leviton electronic time switch with 20 AMP contacts (1000 watt maximum load-adds switches as required to meet loads) and four pre-set time durations for on: 2-4-8-12 hours, model 6212H-I or approved equal.

2.3 TIME CLOCKS

- A. 365 Days Digital Time Clock with Holiday Scheduling
 - 1. Basis of Design
 - a. TORK DWZ-100B
 - 2. Acceptable Alternate
 - a. INTERMATIC ET70115CR
- B. 7 Day Digital Time Clock Flush Mounted without Holiday Scheduling
 - 1. Basis of Design
 - a. EW101BFLG
 - 2. Acceptable Alternate
 - a. ET-1705C with a 2T2365GA Flush Case
- C. 24 Hour 7 Day 4 Channel Digital Time Clock with Holiday Scheduling
 - 1. Basis of Design
 - a. TORK DZS-400BP
 - 2. Acceptable Alternate
 - a. INTERMATIC ET-80415CR

2.4 LIGHTING CONTACTORS

- A. 4-12 Pole Contactors
 - 1. Basis of Design
 - a. TORK 5441
 - 2. Acceptable Alternate

- a. ASCO 917
 - B. 3 Pole Contactors
 - 1. Basis of Design
 - a. TORK 5441
 - 2. Acceptable Alternate
 - a. ASCO 917
 - C. BMS system contractors
 - 1. BMS system contractors provided under another scope. This contractor is to wire through contractor (where indicated in drawings) mounted by BMS contractor. BMS wiring to contactor to be provided by BMS contractor.
- 2.5 TIME CLOCK 2 HOUR OVERRIDE SWITCH
- 1. Basis of Design
 - a. Leviton Model LT-B01-ILZ
- 2.6 CONDUCTORS AND CABLES
- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
 - B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
 - C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
 - D. Wiring for digital sensor system to be provided by manufacturer with cable lengths as coordinated by contractor.

2.7 LIGHTING CONTROL SYSTEMS

- A. Lighting control system Indicated on these documents to be in accordance with lighting consultants specifications, wiring details, and control narrative. See lighting consultants section of project manual for associated specifications.

PART 3 - EXECUTION

3.1 LIGHTING CONTROL INSTALLATION

- A. It shall be contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the Manufactures recommendations. Rooms shall have one hundred (100) percent of coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on drawings are diagrammatic and indicate only the rooms, which are to be provided with sensors. The contractor shall provide additional sensors and coordinate sensor type (i.e. wall/ceiling) if required to properly and completely cover the respective room.
- B. It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.
- C. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations of interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment and problem solving diagnosis of the occupancy sensing devices and systems.
- D. Mask sensors as required to eliminate coverage in unwanted areas.
- E. Program all time clocks. Coordinate programming requirements with owner.
- F. Provide owner facilities personnel with wireless configuration tool.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

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- D. Splices, Taps, and Terminations: Make connections only on numbered copper terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Terminal strips to be provided as required.
- E. Wiring for digital sensor system to be provided by manufacturer with cable lengths as coordinated by contractor.
- F. All low voltage lighting control system wiring above inaccessible ceilings, exposed, and behind walls to be in minimum $\frac{3}{4}$ " from conduit.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust sensor, and any masking and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.
- C. Factory commissioning
 - 1. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system.
 - 2. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the scheduled commissioning date. Upon completion of the system fine tuning, the factory authorized technician shall provide eight hours of the proper training to the owner's personnel in the adjustment and maintenance of the sensors.
 - 3. Submit report signed by manufacturer's authorized technician indicating sensor mode (auto ON/manual ON) sensor sensitivity setting, sensor time out setting, and that the sensor is operating properly for each occupancy/vacancy sensor.

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3.5 ADJUSTING

- A. Occupancy Adjustments: At a date between 8-12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors and any masking to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."
- C. Instruct owner's facilities personnel on how to use wireless configuration tool.

END OF SECTION

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SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

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: Distribution, dry-type transformers rated 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
 - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For transformers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

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2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Qualification Data: For testing agency.
- C. Source quality-control reports.
- D. Field quality-control reports.
- 1.5 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.
- 1.6 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Basis of Design:
 - a. Hammond Power Systems.
- B. Acceptable Alternatives: Subject to compliance with requirements, provide products by one of the following:

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1. Cooper Industries; Cooper Power Systems Division.
2. Cutler-Hammer.
3. Schneider Electric
4. Siemens Energy & Automation, Inc.

C. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Transformers Rated 15 kVA and Larger: Comply with NEMA TP 1 energy-efficiency levels as verified by testing according to NEMA TP 2.
- D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
- E. Coils: Continuous windings without splices except for taps.
 1. Internal Coil Connections: Brazed or pressure type.
 2. Coil Material: Copper.
- F. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- G. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.
- H. Transformer dimensions cannot exceed dimensions of basis of design unit.
- I. Transformers to be K-13 rated or higher.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548 "Vibration Isolation, Wind & Load Restraints For HVAC, Plumbing & Electrical Components"

- C. Cores: One leg per phase.
- D. Enclosure: Ventilated.
 - 1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
 - 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
- E. Enclosure: Ventilated.
 - 1. NEMA 250: Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- F. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: Gray.
- G. Taps for Transformers 3 kVA and Smaller: One 5 percent tap above normal full capacity.
- H. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.
- I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- J. Insulation Class, Smaller than 30 kVA: 185 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.
- K. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.
- L. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.
 - 3. Unit shall meet requirements of NEMA TP 1 when tested according to NEMA TP 2 with a K-factor equal to one.
- M. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

2. Include special terminal for grounding the shield.
 - N. Neutral: Rated 200 percent of full load current for K-factor rated transformers.
 - O. Wall Brackets: Wall brackets fabricated from design drawings signed and sealed by a licensed structural engineer.
 - P. Fungus Proofing: Permanent fungicidal treatment for coil and core.
 - Q. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
 1. Sound levels in accordance with acoustician's requirements.
- 2.4 IDENTIFICATION DEVICES
- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."
- 2.5 SOURCE QUALITY CONTROL
- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
 1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
 2. Ratio tests at the rated voltage connections and at all tap connections.
 3. Phase relation and polarity tests at the rated voltage connections.
 4. No load losses, and excitation current and rated voltage at the rated voltage connections.
 5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
 6. Applied and induced tensile tests.
 7. Regulation and efficiency at rated load and voltage.
 8. Insulation Resistance Tests:
 - a. High-voltage to ground.
 - b. Low-voltage to ground.
 - c. High-voltage to low-voltage.
 9. Temperature tests.
 - B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated from design drawings signed and sealed by a licensed structural engineer.
 - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
 - 2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
 - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.

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- E. Remove and replace units that do not pass tests or inspections and retest as specified above.
- F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

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SECTION 262413 - SWITCHBOARDS

PART 1 - GENERALp

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 and other sections of Division 21.

1.2 SUMMARY

- A. Section includes:
 - 1. Service and distribution switchboards rated 600V and less.
 - 2. Transient voltage suppression devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.
 - 8. Mimic bus.

1.3 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Detail enclosure types for types other than NEMA 250, Type 1.
 - 2. Detail bus configuration, current, and voltage ratings.
 - 3. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 4. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - 5. Detail utility company's metering provisions with indication of approval by utility company.

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6. Include evidence of NRTL listing for series rating of installed devices.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
9. Include diagram and details of proposed mimic bus.
10. Include schematic and wiring diagrams for power, signal, and control wiring.
11. Include riser diagram indicating all panel boards, distribution boards, switchboard, all wire/conduit sizes, board ratings, and switch sizes.

C. Qualification Data: For qualified Installer.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data", include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

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- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
 - E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - F. Comply with NEMA PB 2.
 - G. Comply with NFPA 70.
 - H. Comply with UL 891.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
 - B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.
 - C. Handle and prepare switchboards for installation according to NEMA PB 2.1.
- 1.6 PROJECT CONDITIONS
- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
 - B. Environmental Limitations:
 - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
 - C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.

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2. Altitude not exceeding 6600 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect, Construction Manager, and Owner no fewer than seven (7) days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's, Construction Manager's, and Owner's written permission.
4. Comply with NFPA 70E.

1.7 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate control wiring for indication of switch power failure with transfer switches being provided.
- D. Coordinate metering by customer, (connection to Owner's building management system, etc.).

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

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4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.
7. Provide spare Fuse Cabinet in main utility service room, main energy source power room and rooftop distribution electrical room for extra materials.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide custom built product by Electro-Tech or comparable product by one of the following:
 1. All City Switchboard.
 2. Atlas.
 3. Switchboard on secondary of a medium voltage transformer to be by transformer manufacturer.
- B. Front-Connected, Front-Accessible Switchboards:
 1. Main Devices: Fixed, individually-mounted.
 2. Branch Devices: Panel-mounted.
 3. Sections front and rear aligned.
 4. Only front accessible switchboards will be accepted.
- C. Nominal System Voltage: 208Y/120 V, 480Y/277 V.
- D. Main-Bus Continuous: See Distribution and Switchboard Schedule for ratings. Full size throughout entire board.
- E. Indoor Enclosures: Steel, NEMA 250, Type 1.
- F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- G. Barriers: Between adjacent switchboard sections.
- H. Insulation and isolation for main and vertical buses of feeder sections.

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- I. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- J. Customer Metering: Provide CTS for customer metering. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Metering thru building management system.
- K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard. Bus transition sections to be hard bussed with full size copper phase, neutral, ground bar.
- L. Switchboard doors/panels to be hinged with a door handle on non-hinged side.
- M. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard.
- N. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- O. Bracing: 200k AIC rating.
- P. Pull Box on Top of Switchboard:
 - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 - 2. Set back from front to clear circuit-breaker removal mechanism.
 - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 - 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
 - 6. Size to fit with space allowed.
- Q. Buses and Connections: Three phase, four wire unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, or copper feeder line connections.
 - 2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-

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- breaker position. Load terminals to be oversized to accept sizes of conductors shown on drawings.
3. Ground Bus: 1/4-by-4-inch- (6-by-50-mm-) hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends. All main Buses to be copper.
 5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus. Neutral Buses to be copper.
 6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- R. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- S. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (CB-SMC): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.

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6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and High-Intensity Discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control".
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip upon activation of a remote signal.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - i. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - k. Bolt-on construction
 - l. 20 AMP single pole breakers should be rated for switching duty.
9. Where called for with frame sizes of 50 or 70 amperes, their interrupting ratings shall not be less than 10,000 RMS amperes symmetrical at the applied voltage. Where no frame sizes are indicated, their interrupting rating shall not be less than 10,000 amperes where applied to 200-250/100-125 volts and 14,000 amperes where applied to 420-500/251-300 volts. Otherwise, regardless of the actual applied voltage, their interrupting rating shall be less than as indicated in the following:

Indicated Frame Size	Minimum Acceptable Symmetrical Interrupting Rating in RMS Amperes	
	At	At
	200-250/100-125	420-500/ 251-300
	Volts	Volts

100	14,000	18,000
225	18,000	22,000
400	30,000	42,000
600	30,000	42,000
800	30,000	42,000

- B. Bolted-Pressure Contact Switch (SW - BP): Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Boltswitch, Inc.
 - b. Eaton Electrical, Inc.; Cutler-Hammer Business Unit.
 - c. Pringle Electrical Manufacturing Company, Inc.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
 - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
 - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
 4. Auxiliary Switches: Factory-installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
 5. Service-Rated Switches: Labeled for use as service equipment.
 6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
 - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
 - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
 - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).

- 7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- D. Fuses are specified in Division 26 Section "Fuses".

2.3 SELECTION OVERCURRENT PROTECTION AND SWITCHING

A. General

- 1. Devices shall have voltage ratings suitable for the supply characteristics to which they are applied.
- 2. For devices without protection, provide quick-make, quick-break type distribution switches.
- 3. Select overcurrent protection and switching devices as follows: (unless otherwise noted)
- 4. Explanation of abbreviations used is as follows:

Abbreviation	Description
SW-BP	Distribution switch: bolted pressure type.
SW_QMQB	Distribution switch, quick make-quick break type.
	Fusible - fused with.
CLCF	Current limiting cartridge fuses.
TDCF	Time delay cartridge fuses.
FBOV	Fuse based on use.
CB-SMC	Circuit breaker; standard, molded case type.

B. Application

Acceptable Category of Application	Device Types
Individually-mounted service Disconnect unit	(0-800amps) SW-QMQB/CLCF (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF (OVER 2000 amps) SW-BP/CLCF
Service disconnect unit in Main switchboard	(0-800 amps) SW-QMQB/FBOV (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF (OVER 2000 amps) SW-BP/CLCF

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Feeder unit in main Switchboard	(0-800 amps) SW-QMQB/ FBOV (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF (OVER 2000 amps) SW-BP/CLCF
Branch unit in distribution panel operating with line to line volts in the range of 400 to 600	CB-SMC
Branch unit in distribution panel operating with line to line volts in the range of 200 to 250	CB-SMC
Branch unit in power panel operating with line to line volts in the range of 200 to 250	CB-SMC
Main unit in lighting or appliance panel operating with line to neutral volts in the range of 250 to 300	CB-SMC
Main unit in lighting or appliance panel operating with line to neutral volts in the range of 100 to 125	CB-SMC
Branch unit in lighting panel operating with line to neutral volts in the range of 250 to 300	CB-SMC
Branch unit in lighting panel operating with line to neutral volts in the range of 100 to 125	CB-SMC
Individually-mounted unit (except service disconnect) operating with line to line volts in the range of 200 to 250	(0-800amps) SW-QMQB/ FBOV (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF (OVER 2000 amps) SW-BP/CLCF
Individually-mounted unit operating with line to line volts in the range of 200 to 250	(0-800amps) SW-QMQB/ FBOV (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF
Individually-mounted unit without overcurrent	(0-800amps) SW-QMQB/ FBOV (801-1200 amps) SW-BP/CLCF

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protection	(1201-2000 amps) SW-BP/CLCF
Fusing for fusible combination motor started	TDCF
Fusing for fusible combination motor starter operating with line to line volts in the range of 200 to 250	TDCF

2.4 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control Circuits: 120-V ac, supplied from remote branch circuit.
- C. Control Circuits: 120-V dc.
- D. Electrically-Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- E. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- F. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.6 IDENTIFICATION

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.
 - 1. Nameplate: At least 0.0625-inch- (1.588 mm-) thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.
- B. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
- C. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- D. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
- B. Examine switchboards before installation. Reject switchboards that are moisture-damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete".

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1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Noise Controls for Electrical Systems".
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Install spare-fuse cabinet.
- I. Comply with NECA 1.

3.3 CONNECTIONS

- A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies". Drawings indicate general arrangement of bus, fittings, and specialties.
- B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems". Drawings indicate general arrangement of cable trays, fittings, and specialties.

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- C. Where multiple sets of wires or multiple sets of conduits are indicated on contract drawings, additional lugs are to be provided to accommodate proposed wiring. Quantity of lugs to match quantity of sets of wires or sets of conduits.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems".
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems".
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems".

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

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END OF SECTION 262413

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SECTION 262416 - PANELBOARDS

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 and other sections of Division 21.

1.2 SUMMARY

- A. Section includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Fuse block and fuse type panel boards.
 - 4. Intelligent panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed Voltage Rating.
- B. SPD: Surge Protective Device.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.

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4. Short-circuit current rating of panelboards and overcurrent protective devices.
 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 6. Include wiring diagrams for power, signal, and control wiring, for panelboards provided with contactors and/or shunt trip operators.
 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
- C. Qualification Data: For qualified testing agency.
- D. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
- 1.5 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Member Company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation during construction.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect, Construction Manager, and Owner no fewer than seven (7) days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Architect's, Construction Manager's, and Owner's written permission.
 - 3. Comply with NFPA 70E.

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1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
 - 3. Fuses for Fused Switches and Fuseblocks: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 5. Panelboard installation bolts. 8 spares for each panelboard.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Panelboards shall be molded case bolt-on circuit breaker type, with 100A minimum copper bus, full size neutral and ground bar. (Load centers are not an acceptable substitute for panel boards.)
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. See "Enclosures" Article in the Evaluations for discussion of enclosure types. Coordinate first five subparagraphs below with Drawings (by identifying the designated areas) or schedules (by including the required enclosure type). Availability of some enclosure types are limited by a panelboard's ampacity rating,

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- included devices, or physical size; consult manufacturers for availability of, and limitations on, other than Type 1 enclosures.
 - b. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - c. Outdoor Locations: NEMA 250, Type 3R.
 - d. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - e. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - f. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
- 2. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 3. Panel trim shall be lockable and have hinged "door-in-door" construction.
 - 4. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - 5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: As indicated on riser.
- D. Phase, Neutral, and Ground Buses:
- 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Copper, adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
- 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Oversized to accommodate conductor sizes indicated on drawings.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

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- H. Panelboard Short-Circuit Current Rating and Bus Bracing: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-short-circuit rating by an NRTL. Bus bracing and short circuit current rating to be:
 - 1. 65 KAIC where fault current information is not available and upstream equipment/device rating not available or apparent.
 - 2. As required due to rating calculated from overcurrent protective device coordination study.
 - 3. Equal to or greater than upstream equipment/device rating.
- I. Panelboards located below piping/ductwork to be NEMA 3R (weatherproof) type.
- J. Select panelboards capable of being provided with bolt on breakers only. Panelboards that accept plug on type breakers will not be accepted.
- K. Provide panelboards over 36" high with trim rests.
- L. Panelboards indicated to be provided with main circuit breakers, to be provided with interchangeable mains. Panel boards that require removal of interior when upsizing or downsizing main breakers will not be accepted.
- M. Panelboards indicated as "MP" to be provided with a panel-board branch circuit metering system utilizing ribbon cable CTs similar to Veris Industries Model E30Bx42 with CT option to sit panel-board being provided.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (CB-SMC): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and High-Intensity Discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - i. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - k. Bolt-on construction
 - l. 20 AMP single pole breakers should be rated for switching duty.
9. Where called for with frame sizes of 50 or 70 amperes, their interrupting ratings shall not be less than 65,000 RMS amperes symmetrical at the applied voltage. Where no frame sizes are indicated, their interrupting rating shall not be less than 65,000 amperes. Otherwise, regardless of the actual applied voltage, their interrupting rating shall not be less than as coordinated in the overcurrent protective device study.
10. When a circuit breaker in a panel is rated at over 50% of the main circuit breaker, circuit breaker shall be provided as a sub-feed circuit breaker, (tapping incoming feed prior to main circuit breaker).

- B. High-Pressure, Quick Make-Quick Break Butt-Type Contact Distribution Switch (SW-QMQB): Operating mechanism uses butt-type contacts and a spring-charged mechanism to produce and maintain high-pressure contact when switch is closed.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - b. Schneider Electric.
 2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
 - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
 - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
 4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
 5. Service-Rated Switches: Labeled for use as service equipment.
 6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
 - a. Configuration: Integrally-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
 - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
 - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
 7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- D. Fuses are specified in Division 26 Section "Fuses".

2.3 SELECTION OVERCURRENT PROTECTION AND SWITCHING

A. General:

1. Devices shall have voltage ratings suitable for the supply characteristics to which they are applied.
2. For devices without protection, provide quick-make, quick-break type distribution switches.
3. Select overcurrent protection and switching devices as follows:
4. Explanation of abbreviations used is as follows:

Abbreviation	Description
SW-BP	Distribution switch: bolted pressure type. Distribution switch, quick make-quick break type.
SW_QMQB	Fusible – fused with.
CLCF	Current limiting cartridge fuses.
TDCF	Time delay cartridge fuses.
CB-SMC	Circuit breaker; standard, molded case type.

B. Application

Acceptable Category of Application	Device Types
Individually-mounted service disconnect unit	(0-800amps) SW-QMQB/CLCF (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF (OVER 2000 amps) SW-BP/CLCF
Service disconnect unit in main switchboard	(0-800 amps) SW-QMQB/CLCF (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF (OVER 2000 amps) SW-BP/CLCF
Feeder unit in main switchboard	(0-800 amps) SW-QMQB/CLCF (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF (OVER 2000 amps) SW-BP/CLCF
Branch unit in distribution panel operating with line to line volts	SW-QMQB/CLCF

in the range of 400 to 600	
Branch unit in distribution panel operating with line to line volts in the range of 200 to 250	SW-QMQB/TDCF
Branch unit in power panel operating with line to line volts in the range of 200 to 250	CB-SMC
Main unit in lighting or appliance panel operating with line to neutral volts in the range of 250 to 300	CB-SMC
Main unit in lighting or appliance panel operating with line to neutral volts in the range of 100 to 125	CB-SMC
Branch unit in lighting panel operating with line to neutral volts in the range of 250 to 300	CB-SMC
Branch unit in lighting panel operating with line to neutral volts in the range of 100 to 125	CB-SMC
Individually-mounted unit (except service disconnect) operating with line to line volts in the range of 200 to 250	(0-800amps) SW-QMQB/CLCF (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF (OVER 2000 amps) SW-BP/CLCF
Individually-mounted unit operating with line to line volts in the range of 200 to 250	(0-800amps) SW-QMQB/CLCF (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF
Individually-mounted unit without overcurrent protection	(0-800amps) SW-QMQB/CLCF (801-1200 amps) SW-BP/CLCF (1201-2000 amps) SW-BP/CLCF
Fusing for fusible combination motor starter	TDCF
Fusing for fusible combination motor starter operating with line	TDCF

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to line volts in the range of

2.4 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide custom panel-board provided by Electrotech (contact Tom Cross at 1-914-564-7746) or one of the following:
 - 1. All city switchboard.
 - 2. Atlas.
- C. Panelboards: NEMA PB 1, power and feeder distribution type.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- E. Mains: Circuit breaker, fused switch, fuse blocks and lugs only.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breaker.
- H. Branch Overcurrent Protective Devices: Fused switches.
- I. Branch Overcurrent Protective Device: Fuse blocks.
- J. Contactors in Main Bus: NEMA ICS 2, Class A, electrically and mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- K. Bracing 200kAIC rating.
- L. Provide panelboards over 36" high with trim rests.

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2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide custom Panelboard by Electrotech (contact Tom Cross at 1-914-564-7746) or by one of the following:
 - 1. All city switchboard.
 - 2. Atlas.
- C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- D. Mains: Circuit breaker or lugs only.
- E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- F. Contactors in Main Bus: NEMA ICS 2, Class A, electrically and mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- G. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike. Door in door construction. Load centers are not acceptable alternative for panelboards.
- H. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- I. Interrupting current: Minimum 65k AIC rating.

2.6 FUSE AND FUSE BLOCK TYPE PANELBOARD

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide custom Panelboard by Electrotech (contact Tom Cross at 1-914-564-7746) or by one of the following:
 - 1. All city switchboard.
 - 2. Atlas.

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- C. Panelboards Fuse and Fuse Block Type: Painted red.
- D. Mains - Main Fuse block with fuses sized as per panel schedule.
- E. Branch Overcurrent Protective Devices: Fuse blocks and fuses.
- F. Bus - Panel to be provided with copper Phase buses, copper neutral bus and copper equipment grounding terminal strip. Panel that requires customer wiring to neutral bar and to each fuse block will not be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

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- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory-installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Install 20A 1PH spare circuit breakers in unused spaces.
- H. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- J. Comply with NECA 1.
- K. Existing Panels
 - 1. Drawings indicate new circuits to be added to existing panel. Where new circuits are installed, this contractor shall furnish and install new circuit breakers and relocate existing "spares" to panel spaces. Excess breakers shall then be returned to the Building Owner.
 - 2. New circuit breakers to match existing.
 - 3. Trace out, identify and label all existing circuits to remain.
 - 4. Provide typewritten directories for all existing panel-boards.
 - 5. Clean interior and exterior of existing panel.
 - 6. Paint panel exterior:
 - a. Remove existing, visible rust/corrosion on existing panel.
 - b. Paint with "ANSI Gray 61" color paint.
 - 7. Tighten all connections as determined through equipment infrared scan.
- L. Where multiple sets of wires or multiple sets of conduits are indicated on contract drawings, additional lugs are to be provided to accommodate proposed wiring. Quantity of lugs to match quantity of sets of wires or sets of conduits.

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3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems".
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems".
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems".

3.4 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 10 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

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 and other sections of Division 21.
- B. Vibration and wind criteria for this section is referenced in specification Section 230548. Vendor/manufacturer/contractor is responsible for this Section 230548 in its entirety.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Explosive-proof receptacles.
 - 4. Isolated-ground receptacles.
 - 5. Hospital-grade receptacles.
 - 6. Switches and wall-box dimmers.
 - 7. Solid-state fan speed controls.
 - 8. Wall-switches.
 - 9. Communications outlets.
 - 10. Pendant cord-connector devices.
 - 11. Cord and plug sets.
 - 12. Floor service outlets, poke-through assemblies, service poles, and multi-outlet assemblies.
 - 13. Outdoor outlet and switch enclosures and switches.
 - 14. Multiway switches
 - 15. Pilot light switches.
 - 16. Tamper-proof receptacles.
 - 17. Tamper-proof GFCI receptacles.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic Interference.
- B. GFCI: Ground-Fault Circuit Interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-Frequency Interference.
- E. SPD: Surge Protective Device.
- F. UTP: Unshielded Twisted Pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Schedule indicating:
 - a. Device type.
 - b. Device rating.
 - c. Device application.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Device labeling information.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
1. Where equipment furnished by owner or other trades is indicated or implied, coordinate with owner or other trade for specific.
 - a. Amperage rating.
 - b. Voltage.
 - c. Wiring configuration (quantity & size of neutrals, hots and grounds).
 - d. Nameplate data.
 2. Furnish receptacle type that corresponds with the above.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Service/Power Poles: One for every 10, but no fewer than one.
 2. Floor Service Outlet Assemblies: One for every 10, but no fewer than one.
 3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.
 4. SPD Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 Articles:
1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 2. Leviton Manufacturing Company (Leviton).
 3. Pass and Seymour; a Legrand Company (Pass and Seymour).
 4. Lutron Manufacturing Company (Lutron).
- B. All device finishes to be as selected by Architect at time of submittals.

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125-V, 20A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell; HBL52 Series Simplex in recessed box for clock outlets.
 - b. Hubbell; HBL2162 Style Line Series.
 - c. Pass and Seymour; PT2632W Decorator Series.
 - d. Leviton; 7899 Decora Plus Series.
- B. Hospital-Grade, Duplex Convenience Receptacles, 125-V, 20A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498 Supplement SD.
1. Available Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell; HBL2182 Style Line Series.
 - b. Leviton; 8300 - SG Extra Heavy Duty Hospital Grade Series.
 - c. Pass and Seymour - 26362HGW Heavy Duty Decorator Hospital Grade.
- C. Isolated-Ground, Duplex Convenience Receptacles, 125-V, 20A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; 192182 Style Line Series.
 - b. Leviton - 7380-IG Decora Plus Isolated Ground Series.
 - c. Pass and Seymour - 26362HGW Heavy Duty Decorator Hospital Grade.
 3. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- D. Tamper-Resistant Convenience Receptacles, 125-V, 20A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL8300SG.

- b. Leviton - T5825 Tamper Resistant Decora Series.
 - c. Pass and Seymour - TR26361LA Decorator Tamper Resistant Series.
3. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

E. See drawings for required special receptacles.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125-V, 20A:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; GF5362 Series.
 - b. Leviton; 7899 Non-Tamper Resistant GFCI Series.
 - c. Pass and Seymour 2095W GFCI Specification Grade Series.

2.4 TRANSIENT VOLTAGE SUPPRESSION RECEPTACLES

- A. Convenience Receptacles 125-V, 20A:
- 1. Available Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell; HBL5362WSA Standard Grade TVSS Series.
 - b. Leviton; 7899 Non Tamper Resistant FFEF Series.
 - c. Pass and Seymour 5362 SP Specification Grade TVSS Series.

2.5 SIMPLEX RECEPTACLES

- A. Convenience Receptacles 125-V, 20A:
- 1. Available Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell; SR20W Commercial Grade Series.
 - b. Leviton; 5361 Series.
 - c. Pass & Seymour; 5871 Series.

2.6 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125-V, 20A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell; HBL2310.
 - b. Leviton; 2310.
 - c. Pass & Seymour; L520-R.
- B. Isolated-Ground, Single Convenience Receptacles, 125-V, 20A:
1. Available Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell; IG2310.
 - b. Leviton; 2310-IG.
 2. Description: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.7 WEATHER-PROOF GFCI

- A. Available Products: Subject to compliance with requirements, provide products by one of the following:
1. Leviton - W7899 Series.
 2. Hubbell GFTR20W Series.

2.8 TAMPER-PROOF RECEPTACLE

- A. Available Products: Subject to compliance with requirements, provide products by one of the following:
1. Leviton - TDR20 Series.
 2. Hubbell - PR20ITR Series.

2.9 TAMPER-PROOF GFCI RECEPTACLES

- A. Available Products: Subject to compliance with requirements, provide products by one of the following:
1. Leviton - T7899 Series.
 2. Hubbell - GFTR20 Series.

2.10 HALF DIMMABLE RECEPTACLE

- A. Available Products: Subject to compliance with requirements, provide products by one of the following:
1. Lutron; NTR-20-HFDU.

2.11 EXPLOSION PROOF AC SWITCH

- A. Available Products: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell; FXS-51C.

2.12 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.13 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.14 SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell Style Line Series; HBL2121X (single pole), HBL2222X (two pole), HBL2123X (three-way), HBL2124X (four-way).
 - b. Leviton Decora Plus Series; 5621-26 (single poles) 5622-2W (two pole) 5623-2W (three-way) 5624-2W (four-way).
 - c. Pass and Seymour; Decorator series; 2621W (single Pole) 5622W (double pole) 5623W (three-way) 5624 (four-way).
- C. Pilot Light Switches, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HPL1221PL for 120 V and 277 V.
 - b. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - c. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Leviton; 1221-KL.
 - 3. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with low voltage lighting control relays.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Leviton; 56081-2W SPDT CTR-off momentary contact.

2.15 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with audible frequency and EMI/RFI suppression filters - Lutron Maestro Series, loaded to maximum 80% of dimmer rating. Dimmer type (Incand, Mag L.V., Flour) to match load.
- B. For multi-location dimming use one "smart" dimmer with corresponding accessory dimmers.
- C. Provide matching Lutron switches when ganged in common switch bank.

2.16 FAN SPEED CONTROLS

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 - 1. Continuously adjustable rotary knob, 5 A.
 - 2. Three-speed adjustable rotary knob, 1.5 A.

2.17 COMMUNICATIONS OUTLETS

- A. Telephone Outlet/IT Outlets:
 - 1. Provided under another section.
- B. Combination TV and Telephone Outlet:
 - 1. Provided under another section.

2.18 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Stainless steel.
 - 3. Material for Unfinished Spaces: Stainless steel.
 - 4. Material for Damp Locations: Stainless steel with spring-loaded lockable lift cover, and listed and labeled for use in "Damp Locations" or approved equal.
- B. Wet-Location, Weatherproof Cover Plates: Stainless steel with spring-loaded lockable lift cover, and listed and labeled for use in "Wet Locations" or approved equal. Listed for Wet Locations whether or not the attachment plug is inserted.
- C. Furniture Feed Wall Plates:
 - 1. Provide product indicated below or approved equal:

- a. Pass & Seymour Style 71 metal wall plate.

2.19 FLOOR BOXES

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Solid brushed aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.
- F. Flush-mounted floor receptacles mounted in slabs to be installed in Legrand Wiremold systems Omnibox, brushed aluminum finish as follows (provide matching spec grade 120-Volt 20-Amp receptacles):
 1. Duplex receptacles to be Model 828R coverplate with 817C flange mounted on shallow cast iron box Model 880CM1 2-7/16" deep.
 2. Four-plex receptacles to be (2) Model 828R coverplates with 827C flange mounted on shallow cast iron box Model 880CM2 2-7/16" deep.
 3. Six-plex receptacles to be (3) Model 828R coverplates with 837C flange mounted on shallow cast iron box Model 880CM3 2-7/16" deep.
- G. Flush mounted floor voice/data outlets mounted in slabs to be Legrand Wiremold systems Omnibox, brushed aluminum finish as follows:
 1. Single gang outlets to be Model 829-CK1 coverplate with 817C flange mounted on shallow cast iron box Model 880CM1 2-7/16" deep.
 2. Fourplex receptacles to be (2) Model 829-CK1 coverplates with 827C flange mounted on shallow cast iron box Model 880CM2 2-7/16" deep.
 3. Six-plex receptacles to be (3) Model 829-CK1 coverplates with 837C flange mounted on shallow cast iron box Model 880CM3 2-7/16" deep.

2.20 POKE-THROUGH ASSEMBLIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide Legrand Evolution 6AT Series pokethru, prewired assembly type (coordinate cover type with architect), or products by one of the following:
 1. Pass & Seymour/Legrand; Wiring Devices & Accessories.

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2. Square D/ Schneider Electric.
 3. Thomas & Betts Corporation.
- C. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
1. Service Outlet Assembly: Pedestal type with services indicated.
 2. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 4. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
 5. Complete with 2-20A duplex receptacles and 4 voice data jacks (coordinate jack types with 17).
 6. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, 4-pair, Category 6 voice and data communication cables.

2.21 MULTIOUTLET ASSEMBLIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Wiremold Company (The).
- C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- D. Raceway Material: Metal, with manufacturer's standard finish.
- E. Wire: No. 12 AWG.

2.22 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: Red.
 3. Isolated-Ground Receptacles: Orange.

2.23 RAISED FLOOR BOXES

- A. Description: Factory fabricated round junction box with capacity for power and low-voltage components.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Wiremold CRFB Series:
 - a. Coordinate cover assembly with floor material.
 - b. Hubbell; AFB 801 BK.

2.24 WEATHERPROOF BREAK-GLASS STATION

- A. Description: NEMA 4X Industrial duty emergency break glass station for control of electrically energized equipment.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. IntecModel; I-EBG1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with other trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.

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2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

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- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- J. All receptacles and GFCI receptacles in classrooms, classroom bathrooms and similar areas to be tamper-proof.
- K. Install weather-proof GFCI receptacles in kitchen, pantry or elevator room installations. All receptacles in every kitchen, family room, parlor, library, den, sunroom, bedroom, recreation room, breakfast room, dining room, pantry, bathroom, exterior area, laundry room, basement, garage, hallway, or similar area in a dwelling unit to be tamper-proof type.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems".
 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 2. Test Instruments: Use instruments that comply with UL 1436.
 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 1. Line-Voltage: Acceptable range is 105 to 132-V.
 2. Percent Voltage Drop under 15A Load: A value of 6 percent or higher is not acceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units, and replace with new ones, and retest as specified above.

END OF SECTION 262726

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SECTION 262813 - FUSES

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 and other sections of Division 21.

1.2 SUMMARY

- A. Section Includes:

- 1. Cartridge fuses rated 600-V ac and less for use in enclosed switches switchboards and motor-control centers.
- 2. Plug fuses rated 125-V ac and less for use in plug-fuse-type panelboards.
- 3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
- 4. Spare-fuse cabinets.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

B. Select current limiting cartridge fuses in accordance with the following:

1. Regardless of actual available fault current, they shall, at full recovery voltage, be capable of safely interrupting fault currents of 200,000 amperes RMS symmetrical or 340,000 amperes RMS asymmetrical, deliverable at the line side of the fuse.
2. They shall have average melting time current characteristics to meet the Underwriters Laboratories requirements for "Class J" 0-600 amp fuses and "Class L" over 600 amp fuses.
3. Regardless of actual available fault current, they shall be capable of limiting peak let through current to the following values based on 200,000 amperes RMS symmetrical or 340,000 amperes asymmetrical being available:

<u>Fuse Rating in Amps</u>	<u>Peak Let Through Current in Amps</u>
15-30	8,000
35-50	10,000
70-100	15,000
125-200	25,000
225-400	40,000
500-600	60,000
800	80,000
1000	90,000
1200	100,000
1600	115,000
2000	130,000
2500	145,000
3000	160,000
4000	185,000

4. They shall be applicable to fuse gaps, which reject other types of fusing.

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- C. Select time delay cartridge fuses in accordance with the following:
 - 1. Regardless of actual available fault current, they shall at full recovery voltage, be capable of safely interrupting fault currents of 200,000 amperes RMS symmetrical or 340,000 amperes RMS asymmetrical, deliverable at their line side.
 - 2. They shall have average melting time-current characteristics as necessary to meet the industry standard requirements for time delay fuses.
 - 3. In ratings from fifteen to six hundred amperes inclusive, they shall be applicable to standard fuse gaps. In ratings exceeding six hundred amperes, they shall have terminals suitable for the gaps to which they are to be applied.

- 2.3 PLUG FUSES
 - A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

- 2.4 PLUG-FUSE ADAPTERS
 - A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

- 2.5 SPARE-FUSE CABINET
 - A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

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- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

- 1. Service Entrance: Class L, current limiting.
- 2. Feeders (not including motor feeders or transformer feeders): Class L, for fuses above 600A. Class J, for fuses below 600A. Current limiting.
- 3. Motor Branch Circuits: Class RK5, time delay.
- 4. Other Branch Circuits: Class RK1, time delay.
- 5. Control Circuits: Class CC, time delay.
- 6. Motor or transformer feeders: Class L for fuses above 600A. Class RK5 for fuses below 600A.
- 7. Replace fuses to accommodate recommendations indicated in coordination study.

B. Plug Fuses:

- 1. Motor Branch Circuits: Type S, dual-element time delay.
- 2. Other Branch Circuits: Type S, dual-element time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-Base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- C. Install spare-fuse cabinet in main utility service room, main emergency, power room and rooftop electrical distribution room.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - OVERCURRENT PROTECTION, SWITCHES, ENCLOSED SWITCHES AND
CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this and other sections of Division 21.
- B. Vibration and wind criteria for this section is referenced in specification Section 230548. Vendor/manufacturer/contractor is responsible for this Section 230548 in its entirety.

1.2 SUMMARY

- A. Section includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-Case Circuit Breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.
 - 8. Toggle disconnect switches.

1.3 DEFINITIONS

- A. NC: Normally Closed.
- B. NO: Normally Open.
- C. SPDT: Single Pole, Double Throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, finishes and access points.
1. Enclosure types and details for types other than NEMA 250, Type 1.
 2. Current and voltage ratings.
 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 4. Include evidence of NRTL listing for series rating of installed devices.
 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
 7. Dimensional information.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified testing agency.
- D. Field quality-control reports.
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Manufacturer's field service report.
- F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data", include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect, Construction Manager, and Owner no fewer than seven (7) days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Architect's, Construction Manager's, and Owner's written permission.
 - 4. Comply with NFPA 70E.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All disconnect switches shall be heavy duty with lock bypass capability such that switch can be opened with switch in the "ON" position.

2.2 FUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - 1. Eaton Electrical, Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

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- D. Type HD, Heavy Duty, Double Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
1. Equipment Ground Kit: Copper ground terminal strip internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors where indicated.
 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 7. Lugs: Mechanical type, suitable for number, size, and conductor material. Oversized to accommodate conductor. Sizes indicated on drawings.
 8. Service-Rated Switches: Labeled for use as service equipment.
 9. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.
 10. Red cover paint.
 11. Lockable in "ON" position.

2.3 NONFUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Eaton Electrical, Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- D. Type HD, Heavy Duty, Double Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Provide flush mounted type disconnects for finished areas where indicated.
- F. Accessories:
 - 1. Equipment Ground Kit: Copper terminal strip internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors where indicated.
 - 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical copper type, suitable for number, size, and conductor material. Oversized to accommodate. Sizes indicated on drawings.
 - 7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.4 RECEPTACLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - 1. Eaton Electrical, Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 240-V ac, 60 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 240-V ac, 60 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

- E. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
- F. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.5 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Littelfuse, Inc.
- C. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- D. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- E. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- F. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight red ON pilot light.
 - 3. Isolated neutral lug; 200 percent rating.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
 - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.6 ENCLOSED MOLDED-CASE CIRCUIT BREAKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- F. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- I. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical copper type, suitable for number, size, trip ratings, and conductor material. Oversized to accommodate conductor. Sizes indicated on drawings.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 4. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay

- settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 6. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.
 8. Equipment Ground Kit: Copper ground terminal strip internally mounted and labeled for copper and aluminum ground conductors.
 9. Neutral Kit: Internally-mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 10. Flush-mounted where required.

2.7 MOLDED-CASE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
 1. Standard frame sizes and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 6. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
 7. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.

2.8 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 9.

2.9 TOGGLE DISCONNECT SWITCHES

- A. 20 A 1PH Toggle AC Switch
 - 1. Basis of design product: subject to compliance with requirements provide one of the following products or comparable product:
 - a. Leviton; 1221-SI.
 - b. Hubbell; HBL1221W.
 - c. Pass and Seymour; PS20AC1L.
- B. 30 A 1PH Toggle AC Switch
 - 1. Basis of design product: subject to compliance with requirements provide one of the following products or comparable product:
 - a. Leviton; 1260.
 - b. Hubbell; HBL3031.
- C. 20A 2Pole AC Switch
 - 1. Basis of design product: subject to compliance with requirements provide one of the following products or comparable product:
 - a. Hubbell; CSB220W.
 - b. Leviton; 1222 - SW.
- D. 30A 2Pole AC Switch

1. Basis of design product: subject to compliance with requirements provide one of the following products or comparable product:
 - a. Leviton; 3032 - 2.
 - b. Hubbell; 3002I.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual flush mounted wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.
- E. Where multiple sets of wires or multiple sets of conduits are indicated on contract drawings, additional lugs are to be provided to accommodate proposed wiring. Quantity of lugs to match quantity of sets of wires or sets of conduits.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems".
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

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3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

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- G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

3.6 DISCONNECT SWITCH SCHEDULE

- A. (Unless Otherwise Noted)

Circuit Breaker Disconnect Switches In Other Than Kitchen					*
Where Fused Switches Are Required		*			
Where 20A/30a 2Pole/1PH Unfused Switch Are Required	*				
20A/30A 1Ph/2Pole Unfused Switch In Kitchens	*				
Circuit Breaker Disconnect Switch in Kitchens,				*	

Laundry Rooms, and Similar Areas					
Where > 30A or > 2P Unfused Switches Are Required			*		
	20A/30A IPH/2Pole Toggle Disconnect Switch	Fused Heavy Duty Safety Switch	Unfused Heavy Duty Safety Switch	Flush Mounted Stainless Steel Circuit Enclosed Breakers Type Disconnect Switch	Enclosed Circuit Breaker Type Disconnect Switch

END OF SECTION 262816

SECTION 263111 - ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and other sections of Division 21.
- B. Noise criteria for this section is referenced in specification Section 230548.1. Vendor/manufacturer/contractor is responsible for this Section 230548.1 in its entirety.
- C. National Fire Protection Association (NFPA) - USA:
 - No. 70 National Electric Code (NEC)
 - No. 72-1996 National Fire-Alarm Code
 - No. 90A Air Conditioning Systems
 - No. 92A Smoke Control Systems
 - No. 92B Smoke Management Systems in Malls, Atria, Large Areas
 - No. 101 Life Safety Code
- D. Underwriters Laboratories, Inc. (UL) - USA:
 - No. 50 Cabinets and Boxes
 - No. 268 Smoke Detectors for Fire Protective Signaling Systems
 - No. 864 Control Units for Fire Protective Signaling Systems
 - No. 268A Smoke Detectors for Duct Applications
 - No. 521 Heat Detectors for Fire Protective Signaling Systems
 - No. 228 Door Closers-Holders for Fire Protective Signaling Systems
 - No. 464 Audible Signaling Appliances
 - No. 38 Manually Actuated Signaling Boxes
 - No. 346 Waterflow Indicators for Fire Protective Signaling Systems
 - No. 1481 Power supplies for Fire Protective Signaling Systems
 - No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems
 - No. 1971 Visual Notification Appliances
- E. Local and State Building Codes.
- F. All requirements of the New York City Fire Department.

- G. The Contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other Sections and related to the fire-alarm system shall include, but not be limited to:
1. Sprinkler waterflow and supervisory switches shall be furnished and installed by the fire protection contractor, but wired and connected by the electrical contractor. Modification of existing sprinkler devices to accommodate monitoring by the new fire-alarm system shall be the responsibility of the fire-alarm system-installing contractor.
 2. Duct smoke detectors shall be furnished, wired and connected by the electrical contractor. The HVAC contractor shall furnish necessary duct opening to install the duct smoke detectors.
 3. New air handling and smoke exhaust system fan control circuits and status contacts to be furnished by the HVAC control equipment.
 4. Elevator recall control circuits to be provided by the elevator control equipment vendor.

1.2 SUMMARY

- A. The work covered by this Section of the Specification shall include all labor, equipment, materials and services to furnish and install a complete fire-alarm system of the addressable, non-coded type. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer. The system shall consist of, but not be limited to, the following:
1. Fire-Alarm Control Panel and related remote data gathering panels.
 2. Remote Annunciators with semi flush backbox.
 3. Addressable manual fire-alarm stations.
 4. Addressable analog area smoke detectors.
 5. Addressable analog duct smoke detectors.
 6. Addressable analog heat detectors.
 7. Magnetic door/card access release override control.
 8. Audible notification appliances – Horns.
 9. Visual notification appliances – strobes.
 10. Central station alarm connection control.
 11. Air handling system shutdown control.
 12. Magnetic door holder release.
 13. Sprinkler supervisory switches and tamper switch supervision.
 14. Battery standby.
 15. Kitchen Ansul System Monitoring.
 16. All NYC fire-alarm peripherals, such as placards, riser diagram, necessary switches, LED's, manual central office trip, Fuse Disconnect, FDNY approved locks, with enclosed Purge switches shall be included in the system price. Data gathering panels shall be connected to a power riser with a fuse cutout connection of fused disconnect, a continuous common ground shall be included in the power riser.

1.3 DEFINITIONS

- A. LED: Light-Emitting Diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. This section of the specification includes the furnishing, installation, and connection of an intelligent reporting, microprocessor controlled, addressable, fire detection system for a low rise school building. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified herein.
- B. The fire-alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- C. The system shall be an active/interrogative type system where each addressable device is repetitively scanned, causing a signal to be transmitted to the main Fire Command Center Panel (FACP) indicating that the device and its associated circuit wiring is functional. Loss of this signal at the main FACP shall result in a trouble indication as specified hereinafter for the particular input.
- D. The entire system shall be installed with aesthetics in mind. All control panels and remote annunciators installed in public spaces shall be semi-flush mounted with no exposed conduit or cable trays.
- E. Each designated zone shall transmit separate alarm, supervisory and trouble signals to the Fire-Alarm Control Panel (FACP) and Remote Annunciators.
- F. The fire-alarm system shall meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.
- G. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire-alarm applications and the installation shall be in compliance with the UL listing.
- H. The installing company shall employ NICET (minimum Level III Fire-Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.

1.5 SCOPE

- A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance with the specifications and drawings.
- B. The system shall be designed such that each Signaling Line Circuit (SLC) is limited to only 80% of its total capacity at initial installation.
 - 1. Initiation Device Circuits (IDC) shall be wired Class B as part of an addressable device connected by the SLC.
 - 2. Alarm signals arriving at the FCC shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
 - 3. Notification Appliance Circuits (NAC) shall be arranged such that there is a minimum of two speaker horn and strobe circuits per floor of the building.
 - 4. Notification Appliance Circuits (NAC) speaker horn or strobe circuits and control equipment shall be arranged such that loss of any one (1) circuit will not cause the loss of any other speaker circuit in the system.

C. Basic System Functional Operation

When a fire-alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

- 1. The System Alarm LED shall flash.
- 2. A local piezo electric signal in the control panel shall sound.
- 3. The 640-character LCD display shall indicate all information associated with the fire-alarm condition, including the type of alarm point and its location within the protected premises.
- 4. Printing and history storage equipment shall log the information associated each new Fire Command Center panel condition, along with time and date of occurrence.
- 5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
- 6. The audio portion of the system shall sound the proper audio signal (consisting of tone, voice, or tone and voice) to the appropriate zones.

1.6 SUBMITTALS

A. General Submittal Requirements:

- 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
- 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level IV minimum.

- c. Licensed or certified by authorities having jurisdiction.
3. Provide samples of various items when requested.
4. If equipment of another manufacturer is to be submitted for approval as equal, the contractor shall, at the time of bid, list all exceptions taken to these specifications, all variances from these specifications and all substitutions of operating capabilities or equipment called for in these specifications and forward said list to the Engineer. Any such exceptions, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. Final determination of compliance with these specifications shall rest with the Engineer, who, at his discretion, may require proof of performance.
5. Alternate product submissions based upon use of a product line considered proprietary in its distribution, design, application software, or ongoing maintenance and repair shall not be acceptable. Proof of a product's non-proprietary nature shall be the burden of the contractor at the time of Bid, and shall be in the form of written documentation. The determination of a product's compliance to this requirement shall be exclusively that of the Consulting Engineer.
6. All products used shall be of a single manufacturer. Submission of notification appliances, auxiliary relays, or documentation from other than a single manufacturer shall not be acceptable and will be grounds for immediate disapproval without comment.

B. Shop Drawings

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout, configurations, and terminations.
4. Provide Plan Shop Drawings indicating each exact location of device to be installed, device candela and device DBA. Indicate all conduit risers and all main conduits (to DGPS, FACP, strobe panels and fire-alarm terminal cabinets).
5. Coordinate with mechanical contractor to indicate duct detectors on mechanical shop drawings.
6. Device riser diagram that individually depicts all control panels, annunciators, addressable devices, and notification appliances. Shall include a specific, proposed point descriptor above each addressable device. Shall include a specific, discrete point address that shall correspond to addresses depicted on the device layout floor plans. Drawing shall provide wire specifications, and wire tags shown on all conductors depicted on the riser diagram. All circuits shall have designations that shall correspond with those required on the control panel and floor plan drawings. End-of-line resistors (and values) shall be depicted.
7. Control panel termination drawing(s) shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted

batteries. For each additional data-gathering panel, a separate control panel service and location of the control enclosure. End-of-line resistors (and values) shall be depicted.

8. Device typical wiring diagram drawing(s) shall be provided which depict all system components, and their respective field wiring termination points. Wire type, gauge, and jacket shall also be indicated. When an addressable module is used in multiple configurations for monitoring or controlling various types of equipment, different device typical diagrams shall be provided. End-of-line (and values) shall be depicted.
9. Submit purge system matrix.
10. Submit voltage drop calculations. Provide 20% spare capacity for future expansion of notification devices.

C. Manuals

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.
4. Approvals will be based on complete submissions of manuals together with shop drawings.
5. Provide fire-alarm system Function Matrix.
6. Battery calculations shall be provided on a per power supply/charger basis based on 24 hours of supervision and 15 minutes of alarm. These calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements. Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws. 20% spare capacity must be provided.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the fire-alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

E. Product Data: For each type of product indicated.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.
- F. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.
- G. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FMG-approved alarm company.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 - 1. Notify Architect, Construction Manager and Owner no fewer than two (2) days in advance of proposed interruption of fire-alarm service.
 - 2. Do not proceed with interruption of fire-alarm service without Architect's, Construction Manager's and Owner's written permission.

1.9 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two (2) years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - 3. Smoke Detectors, Fire Detectors Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 5. Keys and Tools: One extra set for access to locked and tamper-proofed components.
 - 6. Audible and Visual Notification Appliances: One of each type installed.
 - 7. Fuses: Two of each type installed in the system.

1.12 GUARANTEE

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.13 POST CONTRACT MAINTENANCE

Polise Consulting Engineers, D.P.C.

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- A. Complete maintenance and repair service for the fire-alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guarantee.
- B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guarantee.
- C. Maintenance and testing shall be on a semiannual basis or as required by the AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:
 - 1. Systematic examination, adjustment and cleaning of all detectors, manual fire-alarm stations, control panels, power supplies, relays, waterflow switches and all accessories of the fire-alarm system.
 - 2. Each circuit in the fire-alarm system shall be tested semiannually.
 - 3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.
- D. The contractor shall have the ability to provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: the catalog numbers used are those of Edwards EST by UTC Fire and Security, and constitute the type and quality of equipment to be furnished. For a list of Edwards EST authorized fire-alarm vendors, contact Dana Ferrer at UTC Fire and Security at dana.ferrer@fs.utc.com:
 - 1. Siemens Building Technologies, Inc.; Siemens Building Technology; 973-396-4144
 - 2. SimplexGrinnell LP; a Tyco International company. Jonathan Ambjor 646-334-4408
 - 3. Notifier supplied by Crossfire. Alan Doorly 718-234-8600

2.2 EQUIPMENT AND MATERIAL, GENERAL

- A. All equipment and components shall be new. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected

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premises protective signaling (fire-alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

- B. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Wiring to be supported every 5' to building structure and within 12" to each junction box.

2.3 CONDUIT AND WIRE

A. Conduit

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. Where possible, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.
4. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and Signaling Line Circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the top of Fire Command Center panels, or any other remotely mounted control panel equipment or backboxes.
6. Conduit shall be 3/4 inch (19.1 mm) minimum.

B. Wire

1. All fire-alarm system wiring must be new. All fire-alarm wiring to be NYC approved FPLP 150 degree 600 volt Teflon.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire-alarm system. Number and size of conductors shall be as recommended by the fire-alarm system manufacturer, but not less than 16 AWG for initiating device circuits and signaling line circuits, and 14 AWG for Notification Appliance Circuits.

3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated above.
5. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.
6. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.

C. Terminal Boxes, Junction Boxes and Cabinets

1. All boxes and cabinets shall be UL listed for their intended purpose.
- D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

2.4 MAIN FIRE COMMAND CENTER

- A. The FACP shall be Edwards (EST) Type EST 3 Series (or equal) shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

B. Operator Control

1. Acknowledge Switch

- a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the 80-character LCD display to the next alarm or trouble condition.
- b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Alarm Silence Switch

Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully

field programmable within the confines of all applicable standards. The FCC software shall include silence inhibit and auto-silence timers.

3. Alarm Activate (Drill) Switch

The Alarm Activate switch shall activate all Notification Appliance Circuits. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch

Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

5. Lamp Test

The Lamp Test switch shall activate all system LEDs and light each segment of the liquid crystal display.

C. System Capacity and General Operation

1. The control panel shall include four Class B (NFPA Style Y) programmable Notification Appliance Circuits.
2. The system shall support up to 8 additional output modules (signal, speaker, telephone, or relay), each with 8 circuits-wired Class A style (see riser diagram for class wiring) circuits can be provided.
3. The Fire-Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color-coded system status LEDs, and an alphanumeric keypad for the field-programming and control of the fire-alarm system.
4. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the Fire Command Center. The system shall be fully programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC-based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
5. The system shall allow the programming of any input to activate any output or group of outputs. Systems which have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.
6. The FCC shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.

- b. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.
 - c. Maintenance alert, to warn of excessive smoke detector dirt or dust accumulation.
 - d. The ability to display or print system reports.
 - e. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification.
 - f. PAS presignal, meeting NFPA 72 3-8.3 requirements.
 - g. Rapid manual station reporting.
 - h. Non-alarm points for general (non-fire) control.
 - i. Periodic detector test, conducted automatically by the software.
 - j. Self-optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal peaks.
 - k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
 - l. Alarm verification for elevator lobby smoke detectors.
 - m. Control-by-time for non-fire operations, with holiday schedules.
 - n. Day/night automatic adjustment of detector sensitivity.
 - o. Device blink control for sleeping areas.
 - p. UL-1076 security monitor points.
 - q. Releasing options including: independent hazards, a sophisticated cross zone, delay and discharge timers, and an abort function. The system shall also include the ability to control low pressure CO₂ valves with the ability to set time in/time out values in one second increments including a soak time of up to 9999 seconds.
 - r. UL-1076 security monitor points.
7. The FACP shall be capable of coding notification circuits in march time, temporal (NFPA 72 A-2-2.2.2), and California Code. Main panel notification circuits (NAC 1, 2, 3 and 4) shall also support special two and three stage operations.

D. Central Microprocessor

1. The microprocessor shall be a state-of-the-art, high speed, 16 bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, non-volatile memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
4. A special program check function shall be provided to detect common operator errors.
5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.

6. For flexibility and to ensure program validity, an optional Windows™ based program utility shall be available. This program shall be used to off-line program the system with batch upload/download. This program shall also have a verification utility which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.

E. Display

1. The display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.
2. The display shall include status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones
3. The display shall include an 80-character back-lit alphanumeric Liquid Crystal Display (LCD). It shall also provide Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE-ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, and ALARM SILENCED.
4. The display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
5. The display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.
6. The system shall support an optional battery ammeter/voltmeter display.

F. Signaling Line Circuits (SLC)

1. The system shall include two SLCs. Each SLC interface shall provide power to and communicate with up to 99 intelligent detectors (ionization, photoelectric or thermal) and 99 intelligent modules (monitor or control) for a system capacity of 396 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
2. The Loop Interface Board (LIB) shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, prealarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
3. The detector software shall meet NFPA 72, Chapter 7 requirements and be certified by UL as a calibrated sensitivity test instrument.
4. The detector software shall allow manual or automatic sensitivity adjustment.

G. Serial Interfaces

1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Electronic Data Processing (EDP) peripherals.
2. One EIA-232 interface shall be used to connect an UL-Listed 40 or 80 column printer. Printers which are not UL-Listed are not considered acceptable substitutes.
3. The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.
4. The EIA-485 interface may be used for network connection to a proprietary receiving unit.

H. Notification Appliance Circuit (NAC) Module

1. The Notification Appliance Circuit module shall provide six fully supervised Class B (NFPA Style Z or Y) notification circuits.
2. The module shall not affect other module circuits in any way during a short circuit condition.
3. The module shall also provide a momentary switch per circuit that may be used to manually turn the particular circuit on or off or to disable the circuit.
4. Each notification circuit shall include a custom label inserted to identify each circuit's location. Labels shall be created using a standard typewriter or word processor.
5. The notification circuit module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal strips shall be UL listed for use with up to 12 AWG wire.
6. Each circuit shall be capable of, through system programming, deactivating upon depression of the signal silence switch.

I. Control Relay Module

1. The control relay module shall provide four Form-C auxiliary relay circuits rated at 5 amperes, 28 VDC. An expansion circuit board shall allow expansion to eight Form-C relays per module.
2. Each relay circuit shall be capable of being activated (change in state) by any initiating device or from any combination of initiating devices.
3. The expansion module shall provide 8 green ON/OFF LEDs and 8 yellow LEDs (indicates disabled status of the relay).
4. The module shall provide a momentary switch per relay circuit that may be used to manually turn the relay ON/OFF or to disable the relay.
5. Each relay circuit shall include a custom label inserted to identify its location. Labels shall be created using a standard typewriter or word processor.
6. The control relay module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal blocks shall be UL listed for use with up to 12 AWG wire.

J. Enclosures

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be provided with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be selected for either right or left hand hinging.

K. Power Supply

1. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
2. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 60 AH or may be used with an external battery and charger systems. Battery arrangement may be configured in the field.
3. The main power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
 - a. Ground Fault LED
 - b. Battery Fail LED
 - c. AC Power Fail LED
4. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FCC.
5. The main power supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge.
6. The main power supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
7. The main power supply shall provide meters to indicate battery voltage and charging current.
8. All circuits shall be power-limited, per 1995 UL864 requirements.

L. Specific System Operations

1. Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FCC shall keep a count of the number of times that

- each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
 4. Point Read: The system shall be able to display or print the following point status diagnostic functions:
 - a. Device status.
 - b. Device type.
 - c. Custom device label.
 - d. View analog detector values.
 - e. Device zone assignments.
 - f. All program parameters.
 5. Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
 6. System History Recording and Reporting: The Fire Command Center shall contain a history buffer that will be capable of storing up to 1000 events. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety.
 - a. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
 7. Automatic Detector Maintenance Alert: The Fire Command Center shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
 8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field-adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
 9. The Fire Command Center shall include a walk test feature. It shall include the ability to test Initiating Device Circuits and Notification Appliance Circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
 - a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.

- b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
 - c. Walk test shall be selectable on a per device/circuit basis. All devices and circuits which are not selected for walk test shall continue to provide fire protection and if an alarm is detected, will exit walk test and activate all programmed alarm functions.
10. All devices tested in walk test shall be recorded in the history buffer.
11. Waterflow Operation

An alarm from a waterflow detection device shall activate the appropriate alarm message on the 80 character display, turn on all programmed Notification Appliance Circuits and shall not be affected by the signal silence switch.

12. Supervisory Operation

Alarm from a supervisory device shall cause the appropriate indication on the 80-character display, light a common supervisory LED, but will not cause the system to enter the trouble mode.

13. Signal Silence Operation

The FCC shall have the ability to program each output circuit (notification, relay, speaker etc.) to deactivate upon depression of the signal silence switch.

14. Non-Alarm Input Operation

Any addressable initiating device in the system may be used as a non-alarm input to monitor normally-open contact type devices. Non-alarm functions are a lower priority than fire-alarm initiating devices.

15. Combo Zone

A special type code shall be available to allow waterflow and supervisory devices to share a common addressable module. Waterflow devices shall be wired in parallel, supervisory devices in series.

M. The Firefighters Smoke Control System - FSCS

- 1. The FSCS shall be utilized for control of both Smoke Control and Post Fire Smoke Purge.
 - a. Smoke control shall include Atrium, Stair, Elevator Shaft Smoke Control as well as zoned smoke control per the project plans and NYC Building Code Section 909, Chapter 4 and Chapter 10 as well as the NYC Mechanical Code.
 - b. Post Fire Smoke Purge shall include post fire smoke evacuation per NYC Building Code Section 912.

2. The FSCS shall be integral to the Fire Command Station or Fire-Alarm Control Panel. It shall include switch/LED modules that provide three position (ON/OFF/AUTO and OPEN/CLOSED/AUTO) switches and 4 LED's (NORMAL, ON, OFF, FAULT or NORMAL, OPEN, CLOSED, FAULT) per each smoke control system controlled as required by NYC Code Section 909.16.
 - a. The FSCS shall be UL 864 and UUKL listed and designed per the NYC Building Code Chapter 9.
 - b. The FSCS shall include 3 position switches for each smoke control system. Each switch shall include ON/OFF/AUTO positions for control of smoke control fan systems and OPEN/CLOSED/AUTO positions for Smoke Control Dampers system.
 - c. The FSCS shall include the following indicators for each smoke control system as required per Section 909 of the NYC Building Code.
 - 1) Fans, Dampers, or other operating equipment in their NORMAL status.
 - 2) Fans, Dampers or other operating equipment in their OFF or CLOSED position.
 - 3) Fans, Dampers or other operating equipment in their ON or OPEN Status.
 - 4) Fans, Dampers or other operating equipment in Fault.
 - 5) Smoke control switch and LED modules shall include a printable portion next to each switch and LED set for a custom descriptor of each smoke control system. The printable portion shall include text and graphical icons indicating the function of the smoke control system.
 - d. Verification All Dampers that are part of the smoke control system shall include verification per Section 09 of the NYC Building Code and NFPA 92A.
 - 1) Verification shall mean end switches (true OPEN and true CLOSED) for each smoke control damper.
 - 2) All fans used for smoke control shall include verification per Section 909 of the NYC Building Code and NFPA 92A. Verification shall mean duct pressure, airflow, or equivalent sensors.
 - 3) The normal indicator shall give the FSCS operator a clear indication that the smoke control equipment is operating properly. Dampers that are not open or not closed (mid-point) shall extinguish the white indicator.
 - e. When a smoke control fan is indexed to start manually or from the fire-alarm system all dampers shall open. When fan is indexed to stop, all dampers shall close unless indicated differently on the project plans.
 - f. Fire detection systems providing control input or output signals to mechanical smoke control systems or elements there of shall comply with the requirements of Chapter 9 and NFPA 72.

3. The FSCS shall include manual post fire smoke purge per Section 912 of the NYC Building Code. Manual smoke purge shall be integral to the FSCS or located on LED/Switch modules directly adjacent to the smoke control controls and indicators. Controls for smoke purge shall only be available after activation of a built-in FDNY/NYC Approved 2642 Key. A 2-position ON/OFF switch shall be included by floor or area for manual evacuation of smoke. Each 2-position switch shall include an indicator that displays when the purge fan is on and a yellow trouble indicator. A graphic diagram indicating the portions for the building served by each post fire smoke purge system shall be included.
4. Fans will not be affected upon system reset. Restarting the fans may be accomplished by turning them back on in an individual sequential fashion or through individual manual switches at the FSCS controls to eliminate the possibility of all fans turning on simultaneously.
5. Under normal circumstances, smoke exhaust fans, respective fire smoke dampers, motorized dampers shall be closed unless noted otherwise on the project plans.

2.5 SYSTEM COMPONENTS - ADDRESSABLE DEVICE (BASIS OF DESIGN COMPONENTS)

- A. Intelligent Devices - General: Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical. Electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary.
 1. Detectors shall be Analog and Addressable, and shall connect to the Fire Command Center panel's Signaling Line Circuits.
 2. The Fire Command Center panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time-of-day basis.
 3. Using software in the FCC, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
 4. The detectors shall be ceiling-mount and shall include a separate twist-lock base, which includes a tamper-proof feature.
 5. The following bases and auxiliary functions shall be available:
 - a. Sounder base rated at 85 DBA minimum.
 - b. Form-C relay base rated 30VDC, 2.0A.

- c. Isolator base.
 6. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
 7. Provide wire guards for detectors in mechanical equipment rooms.
- B. Intelligent Detectors - General: The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.5 seconds. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "Environmental Thresholds". The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminants as well as detector aging. The process shall employ digital compensation to adapt the detector to both long term and digital compensation to adapt the detector to both long term and short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour. The intelligent analog detectors shall be suitable for mounting on any Signature Series detector mounting base.
- C. Fixed Temperature Rate of Rise Heat Detector, (SIGA2-HRS): Provide intelligent combination fixed temperature/rate-of-rise heat detectors. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135°F (57°C) and a

rate-of-rise alarm point of 15°F (9°C) per minute. The heat detector shall be rated for ceiling installation at a minimum of 50 ft (21.3m) centers and be suitable for wall mount applications.

D. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a FACP and UL-Listed central station:

1. The UDACT shall be compact size, mounting in a standard module position of the Fire Command Center cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the Fire-Alarm Control Panel. The Wire connections between the UDACT and the control panel shall be supervised with one pair for power and open pair for multiplexed communications of overall system status. Systems that utilize contact closures are not acceptable.
2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FACP requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.
3. The UDACT shall be completely field-programmable from a built-in keypad and 4-character red, seven segment display.
4. The UDACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.
5. Communication shall include vital system status such as:
 - a. Independent Zone (alarm, trouble, non-alarm, supervisory).
 - b. Independent Zone Addressable Device Status.
 - c. AC ((Mains) Power Loss).
 - d. Low Battery and Earth Fault.
 - e. System OFF Normal.
 - f. 12 and 24 Hour Test Signal.
 - g. Abnormal Test Signal (per UL requirements).
 - h. EIA-485 Communications Failure.
 - i. Phone Line Failure.
6. The UDACT shall support independent zone/point reporting when used in the Contract ID format. In this format the UDACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

E. Printer

1. The printer shall provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. The printer shall be integral to the Fire Command Center. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association Standard EIA-232D. Power to the printer shall be 120 VAC @ 60 Hz.

- F. Photoelectric Smoke Detector, SIGA2-PS: Provide intelligent photoelectric smoke detectors SIGA2-PS. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC. The hot detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications. The percent smoke obscuration per foot alarm set point shall be field-selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment: Temperature: 32°F to 105°F. Humidity: 0-93% RH, non-condensing, Elevation: no limit.
- G. Addressable Carbon Monoxide (CO) Detector, (EST Model SIGA2-COS) with sounder base. Provide intelligent addressable Carbon Monoxide Alarms. The CO detection element shall indicate a trouble condition at the FACP signaling end of life and be field-replaceable. The CO detector shall be UL 2075 listed.
- H. Standard Detector Mounting Bases, (SIGA-SB/SIGA-SB4): Provide standard detector mounting bases SIGA-SB suitable for mounting on North American 1-gang, 3 ½" or 4" octagon box and 4" square box. The base shall contain no electronics, support all detector types and have the following minimum requirements: Removal of the respective detector shall not affect communications with other detectors. Terminal connections shall be made on the room side of the base, bases that must be removed to gain access to the terminals shall not be acceptable. Provide remote LED alarm indicators.
- I. Audible Detector Mounting Base, (SIGA-AB4GT). Where shown on the project plans include detector audible sounder base. The sounder base shall be capable of two tones, Temporal 3 for a fire condition and Temporal 4 for a carbon monoxide condition. The tones shall be fully programmable and also synchronize the sound with other sounder bases. The system shall be UL2017 listed for dual signaling for this purpose.
- J. Duct Detector Housing, Provide Low profile intelligent addressable DUCT smoke detector as indicated on the project plans. Include one Form-C shut down relay rated 2.0 amps @ 30 Vdc and also include slave high contact relays, if required. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. The addressable DUCT housing shall be suitable for its environments, including a temperature range of 5 - 120 degrees F and offer a harsh environment gasket option. Provide Remote Alarm LED Indicators (SIGA-LED) and/or remote test station model (SD-TRK) where required by code.
- K. Intelligent Modules - General: It shall be possible to address each Intelligent Signature Series module without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site

to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or DIP switch and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment: Temperature: 32°F to 105°F, Humidity: 0-93% RH, non-condensing.

- L. Single Input Module, (SIGA-CT1) (Waterflow Detectors, Tamper Switches, etc.): The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64-mm) deep 1-gang boxes and 1 ½" (938-mm) deep 4" square boxes with – gang covers. The single input module shall support the following circuit types; Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active latching (Supervisory, Tamper Switches).
- M. Dual Input Module, (SIGA-CT2): The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" deep 1-gang boxes and 1 ½" (938-mm) deep 4" square boxes with 1-gang covers. The dual input module shall support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).
- N. Single Input Signal Module, (SIGA-CC1): The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The module shall be suitable for mounting on North American 2 ½" (64-mm) deep 2-gang boxes and 1 ½" (38-mm) deep 4" square boxes with 2-gang covers, or European 100-mm square boxes. The single input signal module shall support the following operations: Audible/Visible Signal Owner Selector (Polarized 24 Vdc @ 2A).
- O. Control Relay module, (SIGA-CR): The Control Relay Module shall provide one Form "R" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on North American 2 ½" (64-mm) deep 1-gang boxes and 1 ½" deep 4" square boxes with 1-gang covers.

- P. Manual Pull Station, (SIGA-270): Provide intelligent single action fire-alarm pull stations as indicated on the project plans. The fire-alarm station shall be of metal construction with an internal toggle switch. Finish the station in red with silver "PULL IN CASE OF FIRE" English lettering. The manual station shall be suitable for mounting on North American 2 1/2" (64-mm) deep 1-gang boxes and 1 1/2" (38-mm) deep 4" square fire-alarm pull station without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The manual stations shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A LED shall flash to confirm communication with the loop controller. A LED shall flash to display alarm status. The station shall be capable of storing up to 24 diagnostic codes that can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. Fire-alarm pull stations shall be suitable for temperatures 32°F to 105°F Humidity: 0-93% RH, non-condensing.
- Q. Weatherproof Pull Station, (MPSR1-S45W-GE): Provide conventional single action weatherproof manual pull station shall be red with silver "FIRE-ALARM PULL DOWN" English lettering. The station shall include a weather rated single gang mounting box. Weatherproof fire-alarm manual pull stations shall be suitable for temperatures 5°F to 120°F and 0 to 85% RH, non-condensing. Each station shall be monitored by an addressable monitor module which shall be located in an interior (heated and conditioned) space.
- R. Notification Appliances - General: All appliances shall be UL Listed for Fire Protective Service. All strobe appliances or combination appliances with strobes shall be UL 1971 and ULC S526 Listed. All Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions. Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from the control panel manufacturer clearly stating that the control equipment (as submitted) is 100% compatible with the submitted Notification Appliances.
- S. Temporal Horn Strobes, (G1RF-HVDM Series): Provide low profile wall mount horn/strobes at the locations shown on the drawings. The horn/strobes shall provide an audible output of 84.4 dBA at 10 ft at the high setting and for smaller room size locations (as indicated on the plans) a low dB setting (field-selectable) of 79.4 dBA at 10 ft. when measured in reverberation room per UL-464. Strobes shall provide synchronized flash outputs. The strobe output shall be as indicated on the drawings in one of the following field-selectable intensity levels; 15cd, 30cd, 75cd & 110cd devices. The horn shall have a selectable steady or synchronized temporal output. Low profile horn/strobes shall mount in North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field.
- T. Temporal Horn, (G1RF-HD): Provide EST Series G1RF-HD low profile wall mount horn at the locations shown on the drawings. The horn shall provide an audible output of 84.4 dBA at 10 ft at the high setting and for smaller room size locations (as indicated on the plans) a low dB setting (field-selectable) of 79.4 dB at 10 ft. when measured in reverberation room per UL-464. The

horn shall have a selectable steady or synchronized temporal output. Low profile horn/strobes shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field.

- U. Temporal Horn, (GIRF-HD): Provide EST Series GIRF-HD low profile wall mount horn at the locations shown on the drawings. The horn shall provide an audible output of 84.4 dBA at 10 ft at the high setting and for smaller room size locations (as indicated on the plans) a low dB setting (field-selectable) of 79.4 dB at 10 ft. when measured in reverberation room per UL-464. The horn shall have a selectable steady or synchronized temporal output. Low profile horn shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field.
- V. Weather Rated Strobes, Horns and Horn Strobes: Provide (EST Model WG4) series weather-rated Notification Appliance Circuit (NAC) devices as indicated on the project plans. Weatherproof NAC devices shall be suitable for temperatures 5°F to 120°F and 0 to 95% RH, non-condensing. Weather rated NAC devices shall include a weather resistant color matched mounting box and trim skirt.
- W. Multi-Voltage Control Relays (MR-200 Series): Provide remote control dampers, door releases, etc. Relay contact ratings shall be DPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 24 Vdc, 24Vac, 115 Vac, or 230 Vac. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.
- X. Electromagnetic Door Holders: Provide wall-mounted, (EST Edwards 1504/1505/1508/1509 Series). Provide flush, semi-flush or surface wall mounted electromagnetic door holder/releases rated at 24 Vac/Vdc as directed by the Project Architect. Finish shall be brushed zinc. Electromagnetic door holders submitted for use must have written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purposes intended.
- Y. (STI Stopper II) Lexan Guards: Manual pull stations that are provided with (STI Stopper II) Lexan guards shall include non-audible alarms as required on the plans. They shall be surface or flush mounting, as required for each individual device.
- Z. Projected Beam Detector - Single End (Model EST EC-50/100R): The projected beam type smoke detector shall be a 4-wire 12/24 Vdc device monitored by the Fire-Alarm Control Panel through a two circuit (SIGA-CT2) monitor module (one zone for alarm and one for trouble). The unit shall be listed to UL 268 and shall consist of an integrated transmitter and receiver. The beam detector shall operate between a range of 15 and 160 feet (4.57 and 48.77m) or 160 and 330 feet (48.77 and 100m) (contractor shall determine distance to select appropriate model). It shall feature automatic gain control, which will compensate for gradual signal deterioration due to dirt accumulation on the lenses. The unit shall include a wall-mounting bracket. Testing shall be

carried out using a calibrated test filter. It shall be possible to test the detector without direct access to it by means of a remotely-installed key operated test station.

- AA. Operating Instruction/Riser Diagram Holders: Shall be red painted steel, frame holder with clear, Acrylic window with nine inch by twelve inch (9" x 12") dimensions. One (1) holder shall be provided for the Fire-Alarm Control Panel (FACP) / system operating instructions and one (1) holder shall be provided for a reduced copy (8-1/2" x 11") of the fire-alarm system riser diagram. The operating instruction and riser diagram holders shall be mounted adjacent to the Fire-Alarm Control Panel (FACP).
- BB. Fire-alarm equipment shall be powered through and approved Fuse Disconnect Switch connected ahead of the main service switch. The FDS shall be heavy duty (200,000 rms short circuit amps) safety switch @ 30 amps minimum, painted red, include a ground and neutral kit with grounding screw (to bond neutral), include a padlock with Y1 cylinder keyed to a NYC/FDNY 2642 key (use ABUS re-keyable 83-45 or equivalent lock). All wiring shall be #10 minimum THHN or equivalent run in 3/4-inch EMT/RGS and in accordance with NYC requirements. The ground to the FDS shall be made using a NYC accepted method (see NYC electrical code), and the ground wire to the FDS shall be #8 minimum (larger if necessary to meet feed size). The equipment ground leaving from the FDS connecting to the fire-alarm equipment shall include a #10 green ground. The FDS panel shall bear an engraved white-core phenolic or bakelite identification nameplate stating in minimum one-quarter inch (1/4") high white letters on a red background "FIRE-ALARM FUSED DISCONNECT".
- CC. Where additional circuits are required by the fire-alarm system, a Fused Cutout, properly sized shall be included, wired after the FDS. The size of the fuses shall be sized appropriately but by twenty (20) amperes minimum. The fused cut-out panel shall bear an engraved white-core phenolic or bakelite identification nameplate stating in minimum one-quarter inch (1/4") high white letters on a red background "FIRE-ALARM FUSED CUTOUT". The neutral shall not be bonded in the Fused Cutout".
- DD. Strobes, (GIRF-VM Series): Provide low profile wall-mounted strobes at the locations shown on the drawings. Strobes shall provide synchronized flash outputs. Strobe output shall be field intensity levels; 15cd, 30 cd, 75cd, or 110cd. Low profile strobes shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field.
- EE. Data Gathering Panel (Edwards Model RCC-21)
 - 1. Construction: All cabinets are to be fabricated from 16-gauge steel. The cabinet assembly to consist of two basic parts: a backbox and a locking door.

Cabinets are to be available in either gray or red, with or without LEXAN® windows. This flexibility produces a tasteful combination to accent the décor of the finest lobby setting.

Provide a door, provided with a pin-type hinge, two keys and the necessary hardware to mount the door to the backbox.

The backbox is to be engineered to provide ease-of-entry for the installer. Knockouts are to be positioned at numerous points with a minimum of hardship.

Right- or left- hand hinges, selectable in the field. Door opens 180°.

2. Data gathering panels to be provided with integral tamper switches.

FF. Serially Connected Annunciator

1. The annunciator shall communicate with the Fire Command Center via a two wire EIA 485 (multi-drop) communications circuit.
2. The annunciator shall require no more than four wires for operation. Annunciation shall include: intelligent addressable points, system software zones, control relays, and Notification Appliance Circuits. The following operations shall also be provided:
 - a. Up to 32 annunciators, each with up to 96 points, may be installed on the system.
 - b. The annunciator shall include a single electrical keyswitch to disable all switch functions.
 - c. The annunciator shall provide alarm and trouble resound, with flash for new conditions.
 - d. An optional repeater shall be available which allows the serial data to be repeated, supporting extended wire distances. A version shall also be available for connecting annunciators over a dual fiber optic pair.

2.6 BATTERIES AND EXTERNAL CHARGER

A. Battery

1. Shall be 12 volt, Gell-Cell type.
2. Battery shall have sufficient capacity to power the fire-alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
3. The batteries are to be completely maintenance-free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.
4. Batteries are to be provided with 20% spare capacity.

B. External Battery Charger

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120/240-volt 50/60 hertz source.

2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.
4. Shall have protection for overloads and short circuits on both AC and DC sides.

PART 3 - EXECUTION

3.1 EQUIPMENT EXAMINATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches (1830-mm) above the finished floor. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete".
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830-mm) above the finished floor.
 1. Comply with requirements for seismic-restraint devices specified in Division 26 Section.
 2. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 1. Connect new equipment to existing control panel in existing part of the building.
 2. Connect new equipment to existing monitoring equipment at the supervising station.
 3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- E. Smoke- or Heat- Detector Spacing

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 3. Smooth ceiling spacing shall not exceed 30 feet (9 m)
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A **{or Appendix B}** in NFPA 72.
 5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300-mm) from any part of a lighting fixture.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- G. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- I. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- J. Lexan covers for pull stations:
1. School buildings (required all corridors/vestibules.
 2. Retail: Required in customer accessible areas.
- K. Audible Alarm-Indicating Devices: Install not less than 6 inches (150-mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150-mm) below the ceiling.
- M. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- N. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830-mm) above the finished floor.
- O. Annunciator: Install with top of panel not more than 72 inches (1830-mm) above the finished floor.

- P. Coordinate paragraph below with Drawings. Wind speed is usually a requirement of the applicable building code.
- Q. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that will resist 100-mph (160-km/h) wind load with a gust factor of 1.3 without damage.
- R. All penetration of floor slabs and firewalls shall be sleeved (1" conduit minimum) fire stopped in accordance with all local fire codes.
- S. End of the Line Resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.
- T. All manual pull stations shall be mounted 42 - 48 inches above the finished floor, as measured to the handle.
- U. All audio/visual devices shall be mounted 80 inches above the finished floor, as measured to the lens. Devices shall be mounted no less than 6 inches from the ceiling. Audio visual devices shall be mounted per NFPA 72.
- V. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release.
- W. New door holders shall derive their 24VAC/VDC power from a separate power supply housed in a dedicated, metal enclosure. The power supply shall have a 120VAC feed, and is to be centrally located to serve door holders on a per floor or area basis. All existing door holders shall be connected to new FACP. E.C. shall extend all exiting wiring in order to make this work.

3.2 CIRCULATING GUIDELINES

- A. Each Signaling Line Circuit (SLC) shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices. The loop shall have Class B operation. Each DGP shall include a SLC loop on a per floor basis. T-Tapping a selected loop to cover an alternate floor shall not be accepted.
- B. Each of the following types of alarm notification appliances shall be circuited as shown on the drawings but shall be typically as follows:
 - 1. Audible Signals: Provide sufficient spare capacity to assure that the addition of five (5) audible devices can be supported without the need for additional control components (power supplies, signal circuit modules, amplifiers, batteries, etc.).

2. Visual Signals Provide sufficient spare capacity to assure that the addition of three (3) visual devices can be supported without the need for additional control components (power supplies, signal circuit modules, batteries, etc.).
- C. Where it is necessary to interface conventional initiating devices provide intelligent input modules to supervise Class B zone wiring.
- D. Each of the following types of devices or equipment shall be provided with supervised circuits as shown on the drawings but shall be typically as follows:
 1. Sprinkler Valve Supervisory Switches: Provide one (1) supervisory module circuit for each sprinkler valve supervisory switch.
 2. When waterflow and tamper switches exist at the same location, provide one (1) dual input addressable module. When odd numbers of devices exist at a single location. Provide additional single input addressable modules.
- E. Each of the following types of remote equipment associated with the fire-alarm system shall be provided with a Form 'C' control relay contact as shown on the drawings but shall be typically as follows:
 1. HVAC Fan Systems: Provide one (1) shutdown control relay contact for each HVAC fan system.
 2. HVAC Supply Fans: Provide one (1) shutdown control relay contact for each HVAC supply fan.
 3. HVAC Return Fans: Provide one (1) shutdown control relay contact for each HVAC return fan.
- F. Provide a dedicated 24 VDC circuit to feed all auxiliary relays required for inductive loads. Circuits shall be supervised via an end-of-line relay and addressable input module. Auxiliary relays shall not derive their power from the starter or load being controlled.
- G. Each control or data gathering panel shall have a dedicated 20 Amp-120 VAC minimum feed.
- H. In no case shall any fire-alarm circuit be sized beyond 80% of circuit capacity.

3.3 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 3. Smoke dampers in air ducts of designated air-conditioning duct systems.
 4. Alarm-initiating connection to elevator recall system and components.
 5. Alarm-initiating connection to activate emergency lighting control.
 6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 7. Supervisory connections at valve supervisory switches.
 8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 9. Supervisory connections at elevator shunt trip breaker.
 10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
 11. Supervisory connections at fire-pump engine control panel.
 12. Supervisory connections at engine generator.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.
- C. Fire-Alarm Control Panel enclosures shall have engraved labels indicating, "FIRE-ALARM SYSTEM", and the areas of the building served by that panel.
- D. Auxiliary relays shall be appropriately labeled to indicate "FIRE-ALARM SYSTEM" and their specific function (i.e., FAN S-1 SHUTDOWN).

3.5 SUPPORT FOR INSTALLER AND OWNER MAINTENANCE

- A. Provide a coded one-man walk test feature. Allow audible or silent testing. Signal alarms and troubles during test. Allow receipt of alarms and programmed operations for alarms from areas not under test.
- B. Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors and modules.

- C. Provide loop controller diagnostics to identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the circuit wiring of remote module shall be identified by device address.
- D. Allow the user to display/report the condition of addressable analog detectors. Include device address, device type, percent obscuration, and maintenance indicator. The maintenance indicator shall provide the user with a measure of contamination of a device upon which cleaning decisions can confidently be made.
- E. Allow the user to report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity. Include Facility Name, Licensee, Project Program Compilation date, Compiler Version, Project Revision Number, and the time and date of the History Report.
- F. Allow the user to disable/enable devices, zones, actions, timers and sequences. Protect the disable function with a password.
- G. Allow the user to activate/restore outputs, actions, sequences, and simulate detector smoke levels.
- H. Allow the service user to enter time and date, reconfigure an external port for download programming, initiate auto programming and change passwords. Protect these functions with a password.
- I. THE END-USER SHALL RETAIN COMPLETE RIGHTS AND OWNERSHIP TO ALL SOFTWARE RUNNING IN THE SYSTEM. The fire-alarm equipment vendor shall provide useable hard and soft copies of the software database to the End-User at the end of the warranty period. The database provided shall be useable by an authorized and certified distributor of the product line, and unrestricted use and modification of the database.

3.6 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.7 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by Architect and Engineer.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire-Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 6. Factory-authorized service representative shall prepare the "Fire-Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire-Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Annual Test and Inspection: One (1) year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 BOXES, ENCLOSURES AND WIRING DEVICES

- A. Boxes shall be installed plumb and firmly in position.
- B. Extension rings with blank covers shall be installed on junction boxes where required.
- C. Junction boxes served by concealed conduit shall be flush-mounted.
- D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.
- E. All fire-alarm, function boxes, pull boxes, and closures to be painted red and labeled "Fire-Alarm System".

3.9 CONDUCTORS

- A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
- B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.
- C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, Signal Line Circuits.
- D. All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer recommendations.
- E. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.
- F. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.
- G. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- H. All fire-alarm conductors exposed, or behind walls to be installed in conduit. All other conductors to be provided in plenum rated fire rated cable.
- I. All fire-alarm wiring shall be continuous and unspliced. Terminations shall only occur at fire-alarm devices or control panel enclosures under terminal screws. All other splicing methods are specifically disallowed (i.e., plastic wirenuts).

- J. All fire-alarm wiring shall be installed using a dedicated system of supports (i.e., bridle rings). Fire-alarm warning shall not be bundled or strapped to existing conduit, pipe or wire in the facility.

3.10 DEVICES

- A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.
- B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- C. All devices and appliances shall be mounted to or in an approved electrical box.
- D. All fire-alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the Contract Drawings not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Engineer.
- E. Install fan shutdown relays in separate enclosures from duct detectors. Do not install relays in duct detector housing.
- F. The installing Electrical Contractor shall be responsible for the removal of ENTIRE existing fire-alarm system components and controls. The End-User reserves the right to retain any existing fire-alarm system components, upon their request. All existing fire-alarm system components requiring special handling for disposal (due to radioactivity) shall be the responsibility of the installing contractor.

3.11 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.
- C. A consistent color code for fire-alarm system conductors throughout the installation.
- D. Final system device programming location designations to be based on final room names/numbers (not on design documents). Request from Architect prior to programming.

3.12 ACCEPTANCE TESTING

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- A. A written Acceptance Test Procedure (ATP) for testing the fire-alarm system components and installation will be prepared by the Fire-Alarm Vendor in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.
- B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.
- C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
- D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Owner and test results recorded for use at the final acceptance test.
- E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- F. Final Acceptance Test: Notify the Owner in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test will not be scheduled until megger test results, the loop resistance test results, and the submittals required in Part 1 are provided to the Owner. Test the system in accordance with the procedures outlined in NFPA 72.
 1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 2. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
 3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
 4. Visually inspect all wiring.
 5. Verify that all software control and data files have been entered or programmed into the FCC.
 6. Verify that Shop Drawings reflecting as-built conditions are accurate.
 7. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.

8. Measure voltage readings for circuits to assure that voltage drop is not excessive.
 9. Measure the voltage drop at the most remote appliance on each Notification Appliance Circuit.
- G. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:
1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - a. Open, shorted and grounded Signal Line Circuits.
 - b. Open, shorted and grounded notification, releasing circuits.
 - c. Primary power or battery disconnected.
 2. System notification appliances shall be demonstrated as follows:
 - a. All alarm notification appliances actuate as programmed.
 - b. Visibility at required levels.
 - c. Audibility levels to be demonstrated to ownership for verification that sound levels are not too loud for building occupants and all code minimum DbA requirements are met. All audible notification appliance devices to be set to minimum setting prior to test. All setting increases required to meet code minimum to be included in contractors' scope.
 3. System indications shall be demonstrated as follows:
 - a. Correct message display for each alarm input at the control display.
 - b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
 - c. Correct history logging for all system activity.
 4. System off-site reporting functions shall be demonstrated as follows:
 - a. Correct zone transmitted for each alarm input.
 - b. Trouble signals received for disconnect.
 5. Secondary power capabilities shall be demonstrated as follows:
 - a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.

- b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
- c. System battery voltages and charging currents shall be checked at the Fire Command Center panel.

3.13 APPROVALS

- A. The contractor is required to schedule all inspections with the local fire department in order to obtain the final letter of approval for the work performed and sign-off the building department application as part of the scope of their services. Note that certification of a letter of defect is no longer permitted so additional re-inspections should be included in the contractor's scope of work until the final letter or approval is obtained. Note that a self-certification letter of defect is no longer permitted.
- B. The contractor to prepare and provide the as-built matrix, riser diagram and functionality statement and the matrix. Riser diagrams and functionality statements is to be signed and sealed by applicant of record after applicant of record has verified "as-built" condition of fire-alarm system.
- C. The contractor is to arrange (within adequate time prior to fire department inspections) to a field visit with the applicant of record to verify all devices are installed and operational. Provide all required field labor to locate, uncover, and make apparent, all devices for applicant of record.
- D. If the fire department or building department deems a post approval, amendment is required for project sign-off Fire-Alarm Vendor is to send AutoCAD drawings of as-built riser diagrams, as-built floor plans, and as-built system Function Matrix for Engineer to include in post approval amendment filing documentation. Post approval amendment filing cost and re-inspection fees to be paid for under this contract.

3.14 DOCUMENTATION

- A. System documentation shall be furnished to the Owner and shall include but not be limited to the following:
 - 1. System record drawings and wiring details including one set of reproducible drawings, and a CD-ROM with copies of the record drawings in DXF format for use in a CAD drafting program.
 - 2. System operation, installation and maintenance manuals.
 - 3. System matrix showing interaction of all input signals with output commands.
 - 4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.

5. System program showing system functions, controls and labeling of equipment and devices.

3.15 PROTECTION

- A. Remove and replace devices and panel components that are wet, moisture-damaged, or mold-damaged.

3.16 DEMONSTRATION

- A. Engage a factory-authorized service representative to train. Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.
- B. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall train the employees designated by the Owner, in the care, adjustment, maintenance, and operation of the fire-alarm system.
- C. Training sessions shall cover all aspects of system performance, including system architecture, Signaling Line Circuit configurations, sensor and other initiating device types, locations, and addresses, Fire Command Center panel function key operation, and other functions as designated by the Owner.
- D. Required Instruction Time: Provide 16 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the Owner. The instruction may be divided into two or more periods at the discretion of the Owner. One training session shall be videotaped by the contractor. Videotapes shall be delivered to the Owner.
- E. Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FCC. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the Owner.
- F. Comprehensive system troubleshooting training shall be provided for a single individual designated by the Owner. This session shall be separate and distinct from the above described sessions.
- G. All training sessions shall be conducted following final system certification and acceptance. Three additional training sessions shall be provided for all security personnel on all shifts six months after final system certification.

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- H. All training sessions shall be conducted by an authorized fire-alarm system distributor representative, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.

END OF SECTION 263111